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SPECIAL ISSUE

Functional Sterility in Animals

By H. E. Kingman

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Olitsky and associates of the Rockefeller Institute For Medical Research, have found that mice can be infected with vesicular stomatitis (of horses) when minute amounts of virus are dropped into the nostrils. They conclude it is probable that the disease can be spread by the same route in the field and likely that the near related foot-and-mouth disease of ruminants can be spread in the same way.

The demand for milk goats is apparently increasing. A good milk goat should produce about four quarts of milk daily and one such goat can be practically maintained on kitchen scraps and lawn clippings of a private residence. In some localities goats are rented for $5.00 per month. Where an interest in goat milk can be stimulated in a community the renting of goats is profitable not only to the consumer but also to the renter.

It has been found that the time necessary for rats to mature can be reduced from approximately 90 days to 67 days by selecting vigorous breeding stock and supplying foods rich in vitamines and protein. Probably these findings are applicable to other animals; the saving of one-fourth of the growth period in meat producing animals is of vast economic importance, provided the rapid development is not injurious to health.—*Science*, 1636.

The occurrence of semi-malignant, spindle-celled sarcoma, in tissue affected with chronic inflammation, has been reported by different investigators. The character of the connective tissue cells in chronically inflamed tissues is microscopically very similar if not identical to sarcoma cells and it is possible that irritation may be responsible for some sarcomata.

Hilda Hempl, of the Hooper Foundation of the University of California, reports that a type of colon bacillus is responsible for heavy losses among young lambs, causing a disease resembling white scours in calves. Death is due not to a direct attack of the colon bacilli, but to a poison elaborated by it in the mother's milk in the intestinal canal of the lamb.

The relation of mineral constituents in foods to health and normal development has been demonstrated beyond question. It is possible that certain necessary chemic substances are being exhausted by continuous crop production. Thus it has been found by Evvard and Culbertson that the addition of iodine in the form of potassium iodide to the ration of young growing swine, in dry lot and on rape pasture, resulted in increasing the average daily gain approximately 10% and decreasing the food requirement 10%. It may be found that iodine will also be of value in cattle and sheep feeding.

Functional Sterility

Its Diagnosis and Treatment Based Upon Endocrine and Nervous Control of the Female Genitalia

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A DISCUSSION of the subject of Functional Sterility divides itself naturally into two parts—(1) the physiology of reproduction and (2) the pathology of the various organs or groups of organs involved in the reproductive process. In the following discussion:

Part I deals with the normal state of the genital system during physiologic changes that take place in more or less cyclic periods. It also includes a discussion of some of the means by which one can make practical application of physiologic phenomena.

Part II deals with abnormal conditions that arise as a result of some disturbance in the endocrine or nervous regulation of the functions that have to do with reproduction. It also takes up the routine handling of such cases, including the preparation of operator and patient. This discussion is limited to conditions that are directly related to endocrine and nervous activities or inhibitions and purposely ignores diseases due to infection.

The endocrine-producing organs immediately responsible for the development and activities of the genital tract of the female are the cerebral hypophysis, ovaries and placenta. The udder takes an intimate part in reproduction and is affected by the sex endocrines. It also exerts a marked influence upon the rest of the genital tract but probably does not produce an endocrine of its own.

The anatomy, histology and embryology of each structure listed in the following outline will be discussed very briefly from the standpoint of clinical application.

Outline of Part I

A.—Anterior Hypophysis.
- Location.
- Structure.
  - Size, appearance, blood supply.
- Histology.
- Embryology.
- Physiology.
  - The effect of its endocrines upon the ovaries.

B.—Posterior Hypophysis (Pituitary).
- The action of pituitrin on the uterus, udder and involuntary muscle.

C.—Ovaries.
- Since the examination of ovaries is a part of the routine in the handling of every case of pregnancy diagnosis and sterility, it is increasingly important that the veterinarian be able to detect the slightest changes whether normal or due to disease.
1. Factors that influence or change the size, shape, texture or contour.
2. Nerve supply.
3. Histology.
4. Destiny of cyst (Frei).
   Diagram.
5. Endocrines.

D.—Placenta.
1. Factors that influence nidation.
2. Factors that bring about separation.
3. Endocrines.
   Effect of endocrines upon the uterus and cervix.

E.—Mucus.
1. Physiologic rôle
2. Mucus of estrum.
3. Cervical seal.
4. Changes due to nervous and endocrine influence.

F.—Practical application of reactions produced by sex hormones.
1. Aschheim-Zondek diagnosis of pregnancy.
   Friedman's test.
2. Induction of estrum.
3. Evacuation of uterus—Abortion.

PART I—PHYSIOLOGIC PHENOMENA

BY PHYSIOLOGIC phenomena are meant those changes that take place in the genital system during growth, puberty, estrum, gestation and even parturition. The structures especially involved are the hypophysis, ovaries, tubes, uterus, cervix, vagina, vulva and udder. Other structures of the body also are affected by sex endocrines, particularly the bones and ligaments.

Endocrine influence upon body functions has been known for a long time; during recent years there have been interesting findings in regard to so-called sex hormones. The new developments are of sufficient importance to demand a review of the entire situation.

To understand genital diseases we must be familiar with the physiologic changes produced in the genital tract by the incretions. A careful summary of all factors—history, as well as physical condition—is necessary to enable the veterinarian to differentiate between physiologic and pathologic conditions.

Physiologic changes in the genital system are accompanied by congestion and edema as well as nervous disturbances due to overstimulation or inhibition. They resemble so closely abnormal conditions that continual practice and extensive experience are required to differentiate with certainty between health and disease. It is hoped these facts will be made clear as we progress with the study of the problem.

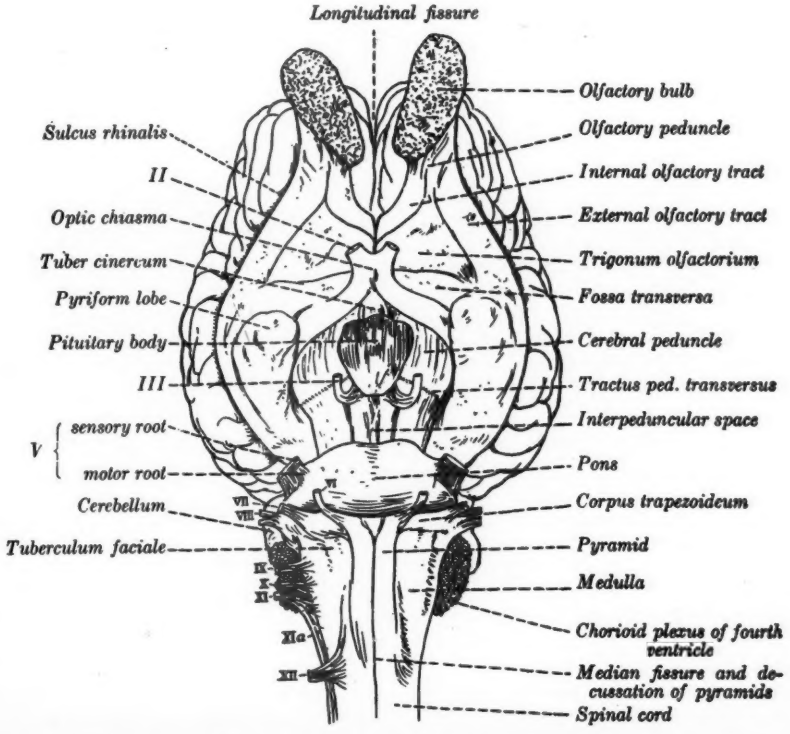


Fig. 1.—Line Drawing of Base of Brain of Horse. From Sisson's Veterinary Anatomy, published by W. B. Saunders Company, Philadelphia.

A.—Anterior Hypophysis

IT IS desirable first to review, briefly, the sex endocrine producing structures and then discuss their practical application. Along with the endocrines must be mentioned the autonomic nervous system since they are intimately related in function.

Location and Size

THE hypophysis of the cow is about the size of an ordinary marble and is completely hidden in a recess on the floor of the cranium. It is covered by a dense fascia—a part of the dura that is thicker here than over any other area.

Its embryonic origin is of little clinical significance but is of interest because of its peculiar early relationships.

The hypophysis is divided physiologically into two portions, viz: glandular and nervous or anterior and posterior pituitary respectively. The actual division into anterior and posterior portions is not well defined. One might be deceived by anatomical separation that enables one to divide the gland into two parts, but these two portions are not the exact functional divisions.

The hypophysis is surrounded by a rich network of arterioles, the *rete mirable*, capable of supplying sudden need for increased blood supply. In other words, while it is not an erectile organ it approximates one, because of its intimate contact with this large vascular plexus. The hypophysis has two separate embryonic origins, (1) an invagination of the primitive buccal epithelium which extends upward from the pharynx forming solid cords of epithelial cells —*pars glanularis*—or anterior hypophysis and (2) the posterior part of the gland of nervous origin, having its beginning in an invagination from the floor of the third ventricle.

This certainly is an odd combination of factors. (1) It is located in an inaccessible pocket surrounded by vital structures. (2) It is of singular embryologic origin. (3) It is an uncommon combination of different tissues, and (4) It possesses a most extraordinary series of functions.

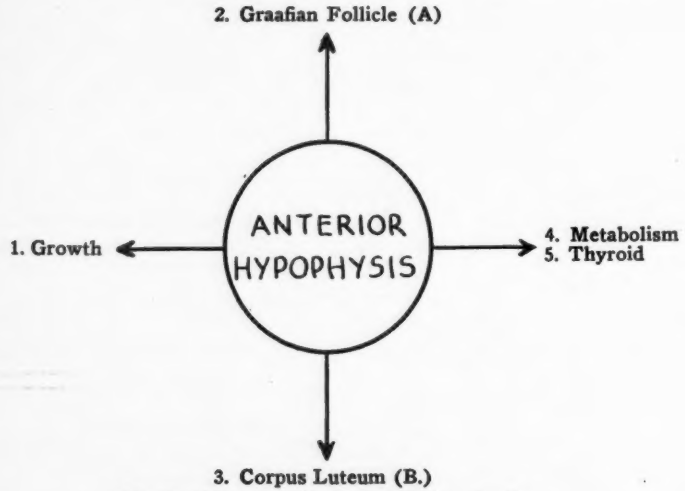


Fig. 2.—The Anterior Hypophysis extends its influence in many directions.

Function

THE hypophysis is the origin of all sex activity associated with the maturation, bursting and luteinization of Graafian follicles. No matter what the origin of the impulse may be, if the Graafian ovulation takes place the message must go first to the anteior hypophysis. In other words, the function of the ovary is dependent upon the force of a product elaborated in the anterior pituitary body.

There is no way of determining the appearance of the body while it is functioning. There is little doubt that it becomes congested but it does not undergo cyclic or anatomic changes as does the ovary.

Nelson, in *Endocrinology,* makes this somewhat startling statement: "We are reaby the hypophysis. I believe that we have sonably certain at the present time that of the entire endocrine series, the hypophysis is the only gland that is fundamentally concerned with normal functioning of the gonads."

It is doubtful if the veterinarian working in the field of genital diseases has grasped the meaning of Nelson's statement, namely, that all reproduction must be set in motion

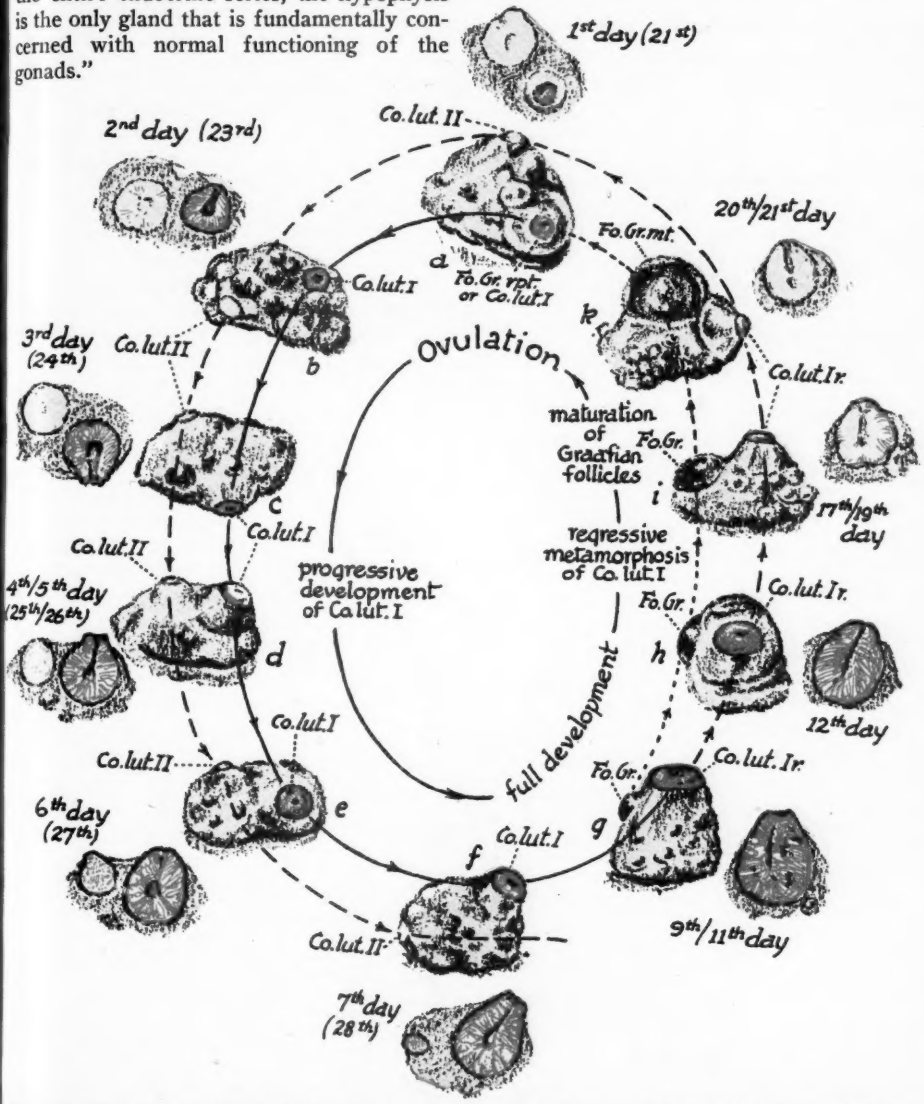


Plate I.—Reading contra-clockwise shows the changes in the ovary during a 28-day period, beginning with rupture of Graafian follicle and formation of corpus hemorrhagicum on the first day (a) one can follow the changes that take place during the 21-day estral cycle (a to k). In addition one can follow the course taken by the corpus luteum (in the outer circle) until it nearly disappears on the 28th day. The outer circle shows the cross sectioned ovary; the inner circle shows the appearance of the entire ovary.—After Max Küpfer.

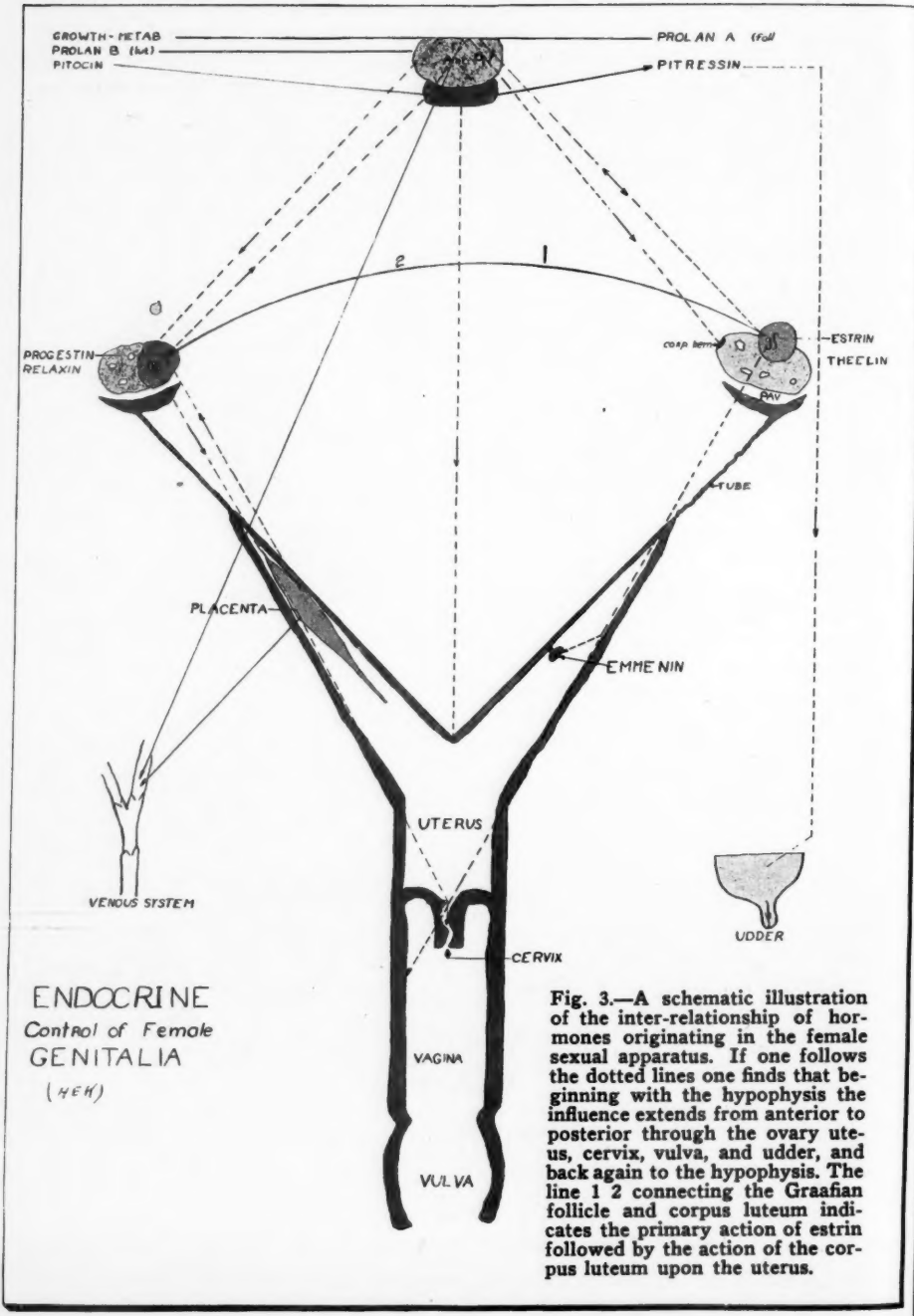


Fig. 3.—A schematic illustration of the inter-relationship of hormones originating in the female sexual apparatus. If one follows the dotted lines one finds that beginning with the hypophysis the influence extends from anterior to posterior through the ovary uteus, cervix, vulva, and udder, and back again to the hypophysis. The line 1 2 connecting the Graafian follicle and corpus luteum indicates the primary action of estrin followed by the action of the corpus luteum upon the uterus.

by the hypophysis. Veterinarians heretofore have looked upon the ovary as the beginning of reproductive activities and have omitted the most fundamental of all sexual glands—the hypophysis.

Let us then proceed with our study of the hypophysis and the rôle it plays in sexual phenomena. There at at least five hormones ascribed to it—a (1) follicle stimulating (2) luteinizing (3) growth influencing (4) metabolism regulating and (5) a thyroid activating hormone.

THE endocrines of the anterior hypophysis affecting the ovaries are called prolan A and prolan B—(hebin D'Amour and Gustavson). When the ovaries are in a condition to accept or receive the influence of prolan A, the Graafian follicles grow, mature, and burst, thereby liberating the ova. Immediately after the rupture of a Graafian follicle there occurs, presumably under the influence of prolan B, the luteinization of the blood clot left in the crater of the ruptured follicle which becomes the corpus luteum. The growth of the corpus luteum of estrum is illustrated in Max Küpfer's chart on the ovary. (See page 349). Our interest at this time is to emphasize the fact that the influence of the ovary upon the rest of the genital tract is dependent first upon the action of the hypophysis.

As to the existence of endocrine force—hypophyseal among others—there is no doubt. The exact nature of such reaction is known and made use of. Its presence in the blood stream and in the urine is demonstrated through the injection of appropriate amounts into the ear vein of immature rabbits and later observing the reaction upon their ovaries. Other means can be used of demonstrating the presence of specific hormones (A and B) in the hypophysis such as transplantation of the hypophysis into the tissues of rabbits and mice.

It is interesting to note the changes that take place in the genital tract of hypophysectomized rats. (Rulot, L)

The hypophysis was removed in a series of animals including a group of adult females. In them the genital tract degenerated, estral cycles ceased to appear, while the Graafian follicles neither matured nor became atretic. The old corpora lutea slowly disappeared and there was no sexual appetite. The weight of the ovaries decreased and the uterus degressed in size. Abortion occurred three days following the intervention.

This is the experience of many other investigators and it leaves no doubt relative to effect of the hypophysis upon the rest of the genital tract.

The veterinarian will encounter instances in which the changes in the genital tract of his patients will resemble very closely the changes described above as being due to hypophyseal influence.

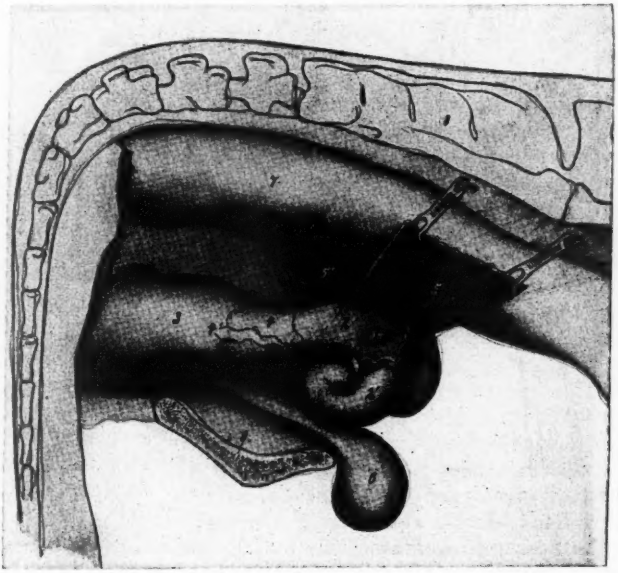


Fig. 4.—Pelvic organs of the cow: (1) uterus, (2) left cornu, (2') right cornu, (3) vagina, (4) cervix, (4') os, (5, 5') broad ligaments, (6) urinary bladder, (7) rectum, (8) sacrum, (9) symphysis pubis.—After Zieger

B.—The Physiologic Phenomena of the Posterior Hypophysis

THE influence of the posterior portion of the pituitary gland extends in an entirely different direction from that of the anterior lobe. The latter—anterior lobe—exerts its force upon the ovaries; the posterior pituitary affects the involuntary muscles of the body and especially those of the uterus. Further it has been found that the product of the posterior pituitary can be split into two dissimilar, physiologically active components called chemical twins. Harrower says in the *Journal of American Chemical Society* 1928: "One of them stimulates the contraction of muscle while the other raises the blood pressure. The first of these, oxytocin, has a marked musculotonic effect and the same peculiar affinity for uterine muscle that has been noted during years of experience with pituitrin. In other words this effect is particularly marked when the uterus is sensitized as at the end of normal gestation. It has no effect on blood pressure, thus making it more suitable for use in labor where the pressor effect is contraindicated, as in the case of uterine inertia with hypertension or even eclampsia."

In this connection one is prompted to ask, what is the relationship of pituitary influence to the hypocalcemias? This question frequently arises as we study the clinical side of endocrine dysfunctions. As for example, what is the effect of the hypophysis in postpartum paresis, (milk fever) fracture of pelvis, cystic ovaries, and eclampsia in cows and bitches? We must wait for the answer, but one may venture the opinion that the relation of endocrines to calcium metabolism plays a part in these phenomena.

"The other hormone of the posterior pituitary," Harrower continues, "the vasopressin, (pitressin) contracts the blood vessels, thereby increasing the arterial tone. But it has no effect upon the uterus. There are occasions when the pressor effect is desirable to control or prevent shock." It also enters the picture in the control of hemorrhage following placental separation, since the physiologic control of such hemorrhage depends upon a combination of factors, that is, coagulability of the blood, blood pressure and uterine involution.

Attention is directed to the danger during arterial hemorrhage in the use of any agent that increases blood pressure. In fact, such agents as adrenalin and pitressin are contraindicated. The control of hemorrhage from the uterine mucosa following forcible (accidental or intentional) removal of fetal membranes depends upon the ability of the blood to coagulate and to the pressure that is brought upon the open vessels by uterine contractions (involution). Therefore it is the oxytoxic action that aids in hemorrhage control and not vasopressor, in spite of the fact that it contracts blood vessels.

THE pituitary gland also has a marked effect upon milk production. The same is thought to be true in regard to the placenta. Here again, the nervous and endocrine effects appear to enter into unison. The observation that nursing brings about uterine contractions and involution, leads to the assumption that a close interrelationship exists. There is only clinical evidence to support the belief that placental extracts start or increase the flow of milk. E. L. Cornell (*Surg.* and *Gynec.* 1918) showed that 87% of babies whose mothers received dessicated placenta by the mouth began to gain by the fourth day as against 69% of those whose mothers did not receive placental extract. This is of interest to the veterinarian since there is a well-known instinct among animals to eat their own fetal membranes.

In the past, the habit has been explained as an inherited or instinctive characteristic that provides protection against predatory enemies. This sounds well and may be true, but it may also be true that digesting the fetal tissues starts or affects the secretion of milk.

At least it would be odd if we, as veterinarians, should find ourselves recommending to the dairyman that the cows be encouraged to eat their fetal membranes in order to induce an increased flow of milk.

C.—Physiologic Phenomena of the Ovaries

THE ovaries of the cow lie with the coils of the uterine horns at the pelvic inlet. To examine them one scoops the uterus into the pelvis with the right hand in the rectum, then with the back of the hand the uterus is waved toward the median line and the ovary is picked up through the walls of the rectum and passed to the left hand (in the vagina). The ovary is then held with the left and palpated with both right and left hands—through the vaginal and rectal walls. Any marked deviation from its normal position must be accounted for. Changes in its usual position may be brought about by pregnancy, fluids in the uterus, adhesions, tumors, fat and digestive organs. The freedom with which the ovaries can be moved about is also to be noted. However, interference with mobility is usually of congenital or infectious origin and not a functional problem.

In the examination of ovaries the veterinarian's first problem is to determine the cause of changes in size and shape whether physiologic or pathologic. One notes more than one factor at a time but it is probable that following location, size is the first to attract attention.

Physiologic Factors Increasing the Size of Ovaries

IN SIZE the normal ovary of the cow varies more than in other domestic animals. Some young Jerseys have ovaries not larger than two or three peas. Mature animals particularly of the larger breed, Holsteins and Herefords, possess ovaries as large as a pecan. Thus the age and breed as well as size of the animal are factors influencing the size of the ovaries.

Growth of the component parts of the ovary, however, is the principal factor involved in bringing about changes in its size. In Küpfer's chart (Plate I) one may see the effect of the Graafian follicle upon the size of the ovary. The Graafian follicle begins at the size of a grain of wheat and reaches normally at maturity a diameter of one centimeter. There may be several follicles of nearly the same size in one or both ovaries. These increase the ovarian dimensions. Upon palpation a Graafian follicle is found to be round like a marble and very smooth. Possibly a slight fluctuation can be detected, at least there is an absence of the doughy feeling that is characteristic of a corpus luteum. It is free from bumps or nodules or scars and when ripe it protrudes from the surface of the ovary. It ruptures upon slight pressure and leaves a crater that normally fills first with blood and later with lutein tissue.

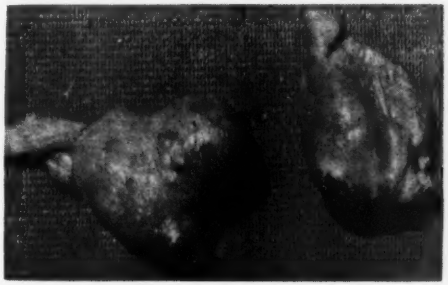


Fig. 5.—Three Copora Lutea present simultaneously; 2 in the left and 1 in the right ovary shown in the cut. Both ovaries are from the same cow

Every 21 days the ovary undergoes this transmutation unless interrupted by pregnancy, dysfunction or disease.

The size of the ovary is also greatly affected by the presence of a corpus luteum or perhaps more than one. I have found three corpora lutea, each of the size of a large marble, present at the same time, two on the right and one on the left ovary. I am speaking only of physiologic changes influencing the size.

THE corpus luteum varies in size, shape and contour, depending in part upon its age, although during pregnancy it remains nearly the same throughout the gestation period. The corpus luteum of estrum cannot be differentiated from the corpus luteum of pregnancy except through history and its rapidly changing size as determined by frequent examination. A new corpus luteum

†See histology of ovary.

is spongy and has a dimpled protuberance twice the size of a pea on its surface. As it becomes older it gradually changes to a round, smooth, slick surface that can be differentiated from the rest of the ovary only with difficulty.

The veterinarian must be able to recognize these changing conditions by palpation.

Fig. 6.—New Corpus Luteum.

A New Corpus Luteum is superficially located and has a dimple or fossa at the top. It feels like rubber and is easily dislodged.

Fig. 7.—Old Corpus Luteum.

An old Corpus Luteum is smooth on top and is not as naked as a new one. It can be removed only with difficulty.

Skill and practice are necessary, in addition to a thorough understanding of the physiology and anatomy as well as the pathology of the part.

Atretic follicles constitute a considerable portion of the mature ovary. They are responsible in part for the increase in size with

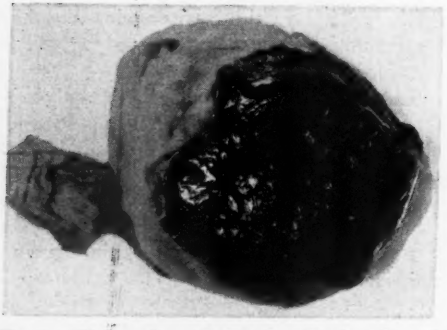


Fig. 8.—Hemorrhage Following Extirpation of the Corpus Luteum.

age. They are probably pathologic and will be discussed further in Part II. Unlike some of the genital organs the ovary is not composed of erectile tissue and does not undergo changes in size because of changes in its blood supply.

Strange to say the ovary is not a highly vascular organ. However, the bursting of a Graafian follicle is accompanied by more or less hemorrhage and the formation of a blood coagulum in the follicular cavity. Occasionally extensive hemorrhage follows the squeezing out of the corpus luteum and failure of the blood to clot may result in the death of the animal. I have been so fortunate as to see this happen only once although I have resorted to the operation frequently. In that one fatal instance the cow had been on sweet clover pasture.

It is probable that the physiologic rupture of a Graafian follicle is sometimes followed by hemorrhage of serious proportions. Evidence of this is occasionally found during routine examination.

Physiologic Factors Decreasing the Size of the Ovary

DIMINUTION in the size of ovaries can be accounted for in part at least by the absence of cyclic changes that result in follicular and lutein growth. Other factors resulting in small ovaries are not easily described. The ovaries do not decrease in size with age, on the contrary there is more likely to be an increase due to the continual addition of scar tissue and a certain amount of fibrosis. Further discussion of factors influencing size of the ovaries will be considered under abnormal conditions.

Histological Structure of the Ovary

THE clinician is not particularly interested in microscopic detailed study of the ovary but one cannot approach the handling of functional disturbances without having an understanding of some of the

histologic changes that take place. Therefore only those features that have a clinical bearing upon the subject will be considered. In a general way the ovary is just a mass of egg-producing follicles held together by connective tissue stroma and a few muscle fibers. The follicles lie in the superficial layers and work toward the periphery as they increase in size and maturity. There are estimated to be 20,000 such follicles in the ovary of a calf. The wall of the follicle consists of two layers of connective tissue, called external and internal theca; and an epithelial lining of a more or less granular nature, called tunica granulosa. The greater part of the gland is covered by germinal epithelium, the peritoneal epithelium being limited to a narrow zone along its attached border. Follicles are often seen projecting from the surface as well as corpora lutea. (Maximow).

At one place in the epithelial layer of the Graafian follicle—granulosa—there is an accumulation of cells within which the ovum is found. This is the beginning of life. True, it has been transferred from some other individual but nevertheless, all of the characteristics of the future individual are in that small ovum and cannot be changed except by influence of the sperm following its fertilization.

ONE may freely admit that very little is known about the real origin of the ovum. There are, however, a few intensely interesting facts that appear to be well established in regard to changes that take place in the ovary incident to its liberation. As one proceeds with the steps in the development of the ovum and fetus one may marvel at the precarious route it travels. Any one of many possible interruptions in the plan of development can terminate definitely the life of the ovum, fertilized ovum, or fetus. If this failure is repeated, the condition may be called sterility.

Beginning with the primary follicle, the following chart shows the possible courses it may take according to Walter Frei in his "Special Pathology."

Primary follice → degeneration
↓
Secondary follicle → degeneration—atresia
↓
Tertiary follicle → Graafian follicle

1.	2.	3.
Death of ovum, absorption of fluid and granulosa with growth of theca interna (atresia).	Ripening and rupture plus growth of granulosa and formation of corpus luteum.	Death of ovum and degeneration of granulosa followed by cystic follicle.
Physiologic and pathologic.	Physiologic.	Pathologic.

At least two factors govern the destiny of the cyst. These are primarily the endocrines and secondarily the autonomic nervous system. These two governing agencies can be observed clinically and are very important factors in the handling of so-called functional sterility. Both groups—endocrine and nervous—are divided into stimulating and inhibitory orders.

LET it be repeated, because of its practical, clinical, significance that the ovary can produce its hormones in a normal manner *only* when its is properly governed by the hypophysis. Therefore in the above chart the changes occurring in ovarian tissues whether physio- or pathologic take place, in part at least, because of the influence, or lack of influence, of the hypophysis.

In addition to the effect of the ovary upon the genital tract the endocrines produced by the ovary have a marked influence upon the size, shape and contour of the body. In fact, they produce those characteristics that are called feminine. Even the voice, disposition and mental phenomena are modified by the presence or absence of certain incretions elaborated by the ovaries.

Ovarian Edocrines

THE ovarian hormones influencing the genital tract are (1) folliculin (P. D. theelin) formed in the Graafian follicle and corpus luteum; and (2) progestin presumably a product of the corpus luteum.

At first thought one might assume that from the standpoint of practice one would be interested only in the effect that sex hormones have upon the genital tract. This, however, is not the case since one depends in diagnosis to a great extent upon physical manifestations that are related to sex endocrine influence. For example, the diagnosis of a so-called "free martin" can sometimes be made by observing the development of the udder and masculine features of neck, head and horns. Many other instances might be given where a sex dysfunction is diagnosed by signs that are not a part of the genital system.

The following diagram illustrates the radiating influence of the ovary.

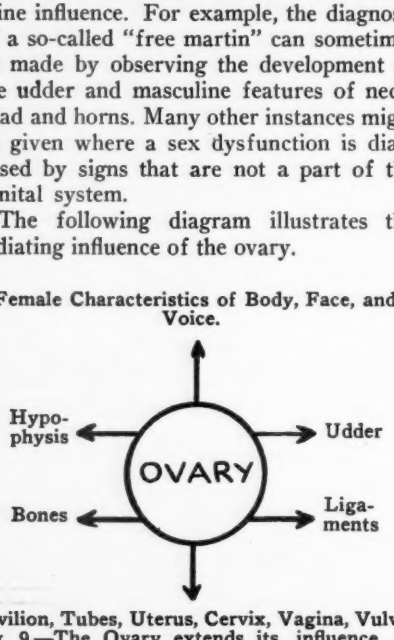


Fig. 9.—The Ovary extends its influence in many directions.

1. *Estrin.*—The first of importance among female sex hormones is folliculin, called estrin or theelin. Elaborated by the follicle it is found later in the corpus hemorrhagicum, corpus luteum and the placenta. It is found in smaller quantities in the body fluids of the cow than in any of the other domestic animals. While the blood and urine of the mare are comparatively rich in both hebin (prolan) and estrin.

The laboratory test for estrin is performed upon spayed rats. The injection of estrin into a spayed rat brings about definite changes in the vaginal mucosa, cervix, vagina and vulva. The secretion of mucus is very much modified as well as the gross anatomy of the genital tract. The physical and mental phenomena that, taken together, make up the signs of estrum are brought about under the influence of estrin (Theelin, P. D. & Co.).

It is important to review these phenomena at this time, although they are perfectly familiar to every veterinarian. It is the relation of signs—phenomena—to endocrines that is somewhat new and of clinical significance. Among the first signs of estrum is the stimulation of a secretion that carries a very definite odor. Whether one species of animal can detect this odor in other species is not certain. It is probable that they can, at least, to some degree. But as to the male of the same species there is no doubt. Even though blind and deaf he cannot be deceived in regard to that odor. He can also recognize it at a great distance. Of course, it is not possible to know just how far such a scent carries since there are other means of communication.

The voice of both male and female is changed during the rutting season or estral periods. Wild carnivora that through their cunning are able to evade all efforts on the part of man to destroy them are easily lured into traps by urine from bitches in heat. Bulls and stallions test the estral stage by a peculiar method of smelling the mucus discharged from the vulva. In the human alone is the sense of smell insufficiently developed to be of much aid in such matters.

Psychic Phenomena.—Psychic changes are pronounced during this period. The flow of milk is disturbed, the subject becomes both playful and cross. In fact apparently they themselves do not know what their next move may be. Whether irritability is due to cerebral congestion or just what causes so-called tenseness of nerves is not easily explained. At least the tenseness is there during estrum, as well as in early pregnancy.

The rôle of the sympathetic system and its relation to endocrine function comes to the foreground now but it is necessary to postpone its discussion until later.

Physiologic Action of Estrin Upon Genital Tract.—Estrin brings about physical changes that are in evidence throughout the entire genital system. Beginning at the pavilion the entire apparatus, including the vulva and udder responds to the action of estrin. One cannot account for the great variation among species in quantity and difference in physical phenomena —signs produced by estrin. For example, in the human the pavillion during menstruation looks almost like "proud flesh" while in the cow it remains practically unchanged. In no case, in a study of many fallopian tubes of cows, has the slightest congestion or swelling in the pavillion been detected. Neither does the tube undergo microscopic changes during estrum in the cow. The uterus shows a tendency to become erect and the mucous membranes are red and congested while the resting maternal cotyledons are more visible than usual. There is an increased flow of blood to the entire wall of the uterus as well as to its mucous membrane. Accordingly one may assume that estrin performs a sensitizing duty in preparing the uterine mucous membrane for nidation and further development of placenta.

It is thought that the stabilization of the ovum and its placenta is affected by the corpus luteum hormone-progestin—an entirely different agent from estrin. If this is true there is "1-2" agreement between estrin and progestin in their action upon the mucous membrane of the uterus. One has preparatory action and the other a continuing nutritive effect. "Folliculin regulates all sexual manifestations while progestin (corp. lut. hormone) governs the processes of gestation."—L. Rulot.

If estrin is injected into a spayed rat the genital tract will undergo the changes common to estrum.

The glands of the cervix become active during estrum and its lumen dilates sufficiently to permit the introduction of one finger through the first two annular rings. Viewed through a lighted speculum the cervix is a darker red than during diestrum and the clear mucus in which it is bathed makes its surface glisten.

The size, shape and firmness of the cervix as well as the patency of its lumen, can be determined by palpation, but its color and anatomical morphology can be observed only through the use of some lighted instrument and even then one must realize that the inrush of air into the vagina or the touching of the cervix with the speculum causes congestion and redness that must not be mistaken for a pathologic condition. At rest—diestrum—the cervix is pale, its plicated palm is closed and its lumen is filled with a mucus that resembles the cervical seal of pregnancy.

Estrin, however, causes the mucous membrane of the cervix to be engorged. It is sensitive and bleeds easily. The slightest stimulation causes it to blush a deep red. The mouth of the cervix opens as a result of the engorgement—erection —and a glassy, glary mucus escapes from its lumen in large amounts. From these facts it will be seen that the history of the case—the date of last estrum—may have a marked bearing upon the diagnosis, since the signs described above are very nearly those of inflammation due to infection and may confuse the diagnostician.

THE effect of estrin upon the vulva is more pronounced in carnivora than herbivora. The vulva of the bitch for example becomes greatly swollen, a sort of permanent erection. However, under the continued effect of estrin, *i.e.*, over a period of several weeks, the vulva of the cow becomes edematous and firm as if undergoing fibrosis. This condition occurs during nymphomania and is associated with cystic degeneration of the ovaries. In health during the later months of gestation the vulva becomes flabby and edematous. This is undoubtedly due to estrin. However, another hormone called relaxin is thought to be responsible for the softening of the sacro-iliac ligaments and may likewise cause edema of the vulva; which

a few days prior to parturition, in preparation for the delivery of the fetus, hangs down over the ischial arch like a great "sloppy sack" from which escapes the rapidly dissolving cervical seal plus a clear mucus like that of estrum.

In addition to its action upon the posterior genital tract, estrin exerts a restraining influence upon the ovaries. This is probably brought about by way of inhibition of the hypophysis (Gustavson, D'Amour, Rulot, and Zondek.) It should be observed that no endocrine has a direct action upon the gland that manufactures it.

It should be added that if there is a concerted action between the follicular fluid and the corpus luteum, what we call a "1-2" action—estrin sensitizing the mucous membrane for the action of progestin —then it must also be convenient to call the placenta and hypophysis action a "3-4"

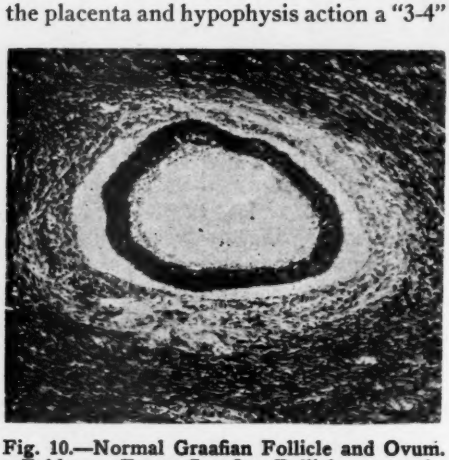


Fig. 10.—Normal Graafian Follicle and Ovum. —Feldman. Every Graafian Follicle approaching maturity contains an ovum. If the ovum dies the progress of follicular development is interrupted and it either becomes atretic or cystic.

action, since the hypophysis does not stimulate ovulation so long as the placenta is intact unless the normal chain of control is broken through dislodgement or absorption of the corpus luteum.

The corpus luteum.—Increasing in size during its early development, the corpus luteum reaches an inch in diameter at about the 15th day following rupture of the Graafian follicle. From the 16th to the 21st day it rapidly diminishes in size, apparently releasing its inhibitory control of the hypophysis until another follicle is ripened and bursts. The cycle is then repeated until interrupted by pregnancy, dysfunction or disease. (See chart on ovarian cycle, page 349.)

The corpus luteum exerts an inhibitory influence upon the genital tract. Through the effect of progestin it encourages nidation—nesting—of the ovum and continues

Fig. 11.—Normal Granulosa lining Graafian Follicle.—Feldman.

its support during the gestation period. So long as the corpus luteum remains stationary the Graafian follicles will not burst. This must be due to an inhibitory action upon the anterior hypophysis. The final effect, however, is a restraining influence upon the follicle. If the corpus luteum is dislodged, then a follicle matures and bursts within a comparatively short time. As a result, the contents of the uterus will be evacuated, and another heat period will occur at the regular interval. The belief that ovaries alternate in ovulation is not always true and probably is infrequent. Cows with only one ovary come in heat at regular 21-day intervals. Any accident that may befall the corpus luteum, especially through the early periods of gestation, is certain to result in evacuation of the uterus. In the study of the abortion problem, factors influencing the corpus luteum must be given due consideration.

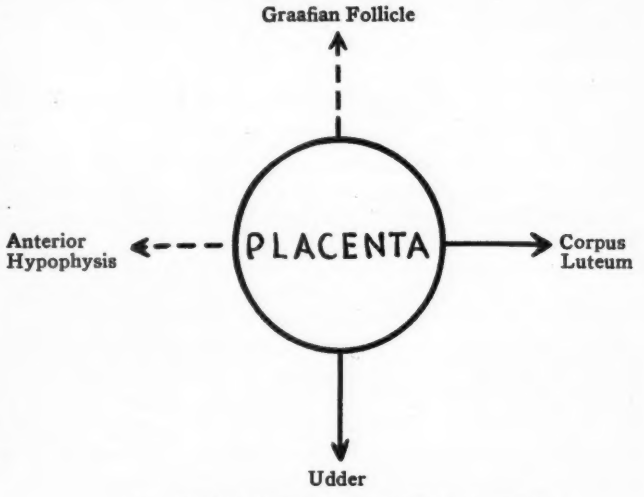
D.—Physiologic Phenomena of the Placenta

THE placenta, in the form of a soft membranous blanket, completely surrounds and separates the fetus from external contact. On the other hand, it serves as a medium of communication and protection. One of its important duties is the detoxification of all substances passing through it to the fetus. It, of course, makes use of all *defensive factors* common to other tissues of the body, membraneous, reactive, humeral and cellular. In addition to these, the placenta, according to Brahn, carries an antitoxic pigment, melanin, that is believed to be of great value.

Zondek also calls attention to the presence of vitamin A in the placenta in considerable quantities. Vitamin A is the growth factor.

Harrower quotes from "Practical Hormone Therapy": "In the body every motive force is balanced by a retarding force . . . and this nice equilibrium is quite essential to the proper regulation of the numerous cellular functions. Should one of two factors gain the ascendency, disorganization may be expected at once and the extent of this disturbance can hardly be confined to the single area in which it is initiated." This is what happens when the corpus luteum of pregnancy is disturbed. The anterior hypophysis being no longer restrained goes into action, a follicle is hastily ripened and bursts, the placenta releases its intimate attachment and the fetus dies. But so long as the placenta remains attached it inhibits the hypophyseal and ovarian activities. Whether this inhibitory action is entirely due to something in the placenta may also be questioned since accumulations of fluids within the uterus apparently also have an inhibitory effect and may not be expelled until a corpus luteum is dislodged.

IN general, the placental hormones are in cooperation with the corpus luteum and mammae and are antagonistic to the follicle. This latter is not easy to understand since the placenta takes over the manufacture of estrin while the follicle remains dormant. In fact, it produces so much estrin that the blood stream becomes flooded and the renal threshold is overflown, liberating large quantities in the urine. Further, the whole situation is reversed at the time of parturition when all restraining factors are brushed aside and the uterus goes into action in the form of labor.



Key: Solid lines=Cooperates with—stimulates
Broken lines=Antagonistic to—retards
Fig. 12.—The influence of the Placenta extends to many organs

THE placenta of the mare, woman and ewe is known to be rich in estrin but that of the cow contains very little. In fact, the cow presents a different picture so far as endocrines are concerned and it is the veterinarian's problem to account

for these differences and to make application of such knowledge in the diagnosis of genital diseases. There is also much to be learned relative to the influence of the placenta upon the udder. In 1905 Halban advanced the theory that a placental hormone was responsible for hyperplasia of the breast and uterus independently of the ovaries. It is a fact that prior to abortion the cow's udder undergoes changes resembling inflammation, and the milk is altered in quality. This interrelationship of placenta and udder is an important factor in the understanding of diseases of either. If the placenta takes part in fibrosis or hyperplasia of the udder and the massage of the udder can stimulate the flow of mucus in the vagina, then it is possible that the endocrine-nervous influence common to both these reproductive organs plays a part in their resistance to infection.

E.—Mucus.—Its Physiologic Role

LITTLE has been said relative to the part played by mucus as a defensive tissue, yet it takes its place along with the other barriers that protect vital structures from injury. It is a normal product of columnar epithelial cells, lining ducts and glands and adds moisture to all mucous membranes. Those secreting mucus are called goblet cells and lie between the ordinary columnar type. Mucus serves as medium for the movement of leucocytes that are commonly found on mucous surfaces and between the bodies of columnar cells.

I can find no reference to the antitoxic properties of mucus but it must be rich in antibodies as well as leucocytes. Like any other emollient, mucus softens, protects and ensheaths the tissue it covers. It acts as a moist mechanical barrier to invading bacteria and prevents the escape of fluids from tissues. In health it is usually clear, although it sometimes is turbid from being mixed with epithelial cells and leucocytes, such condition being not necessarily pathologic. It may even be stained with blood and still be physiologic. This is one of many examples where our attention is directed to the necessity of differentiating between normal and pathologic reactions. When mixed with pus, mucus is yellow. This of course is pathologic. The viscosity of normal mucus as it is found in the genital tract is modified by a number of different factors. When found in the uterus it is mixed with the product of the uterine glands, giving it a slightly brown tinge, and such mucus is sometimes called uterine milk.

There is considerable difficulty entailed in drawing a clearly differentiating line between normal and abnormal uterine fluids, at least such has been the writer's experience. One must be guided largely by their physical properties. In the cervix mucus changes with the estral period, varies slightly during pregnancy and gives evidence of the presence of irritants through modifications in its viscosity, color and odor. During estrum it collects in the vagina in copious quantities. It is cohesive, clear and thicker than egg albumin. It may hang from the vulva in a great "gob." It acts as a lavage of the genital tract and serves as a vehicle for the movement of sperms. When the ovum is fertilized the mucus of the cervix becomes tough and gelatinous. At first it is clear, then turbid and with age turns to more or less of an amber color.

The amount of mucus required to close the lumen of the cervix during pregnancy depends upon the size and condition of the cervix. In a heifer the cervix is not larger than one's thumb and its lumen can be plugged with a small core of mucus. But in older cows that have had several calves the cervix is large and the lumen takes perhaps an ounce or more of gelatinous mucus. If the cervix has been lacerated or infected, in addition to other reparative processes, mucus enters the picture. It fills all cracks and gaps. Even though the lumen be as large as a broom stick, mucus plugs the passage. It is tough, tenacious, elastic and durable. It is cemented to all mucous surfaces, leaving no part exposed nor any opportunity for the passage of fluids either out or in. The seal

is perfect. Remember we are discussing endocrine activities and that the mucus of estrum, the cervical seal, and other normal amounts of healthy mucus of the genital tract are more or less under the influence of certain endocrines.

IT has been shown that mucus is a very important factor in reproduction. When the genital tract is at rest, mucus bathes its surface, "washes its face if you please" and performs, in general, a sanitary function. It facilitates copulation and facilitates the passage of the sperm toward the fallopian tube. Upon fertilization of the ovum, among other things it seals the cervix, enabling the embryo to develop in a medium in no way exposed to the outside atmosphere or conditions. As parturition approaches, the seal softens along with the cervix. It releases its hold upon the mucous surfaces and its character changes to that of a lubricant to facilitate the passage of the fetus through the cervix and posterior genital tract. Following parturition it again takes over the duty of lavage and protection.

A veterinarian even of wide experience, a sound training and continual practice will still find that there is a great deal left to learn about mucus. Its character changes often in health and in the presence of disease it unites with the other defensive factors of the body. It is modified by the reaction of the tissues and the presence of toxins and other substances such as milk, urine and fetal fluids.

To know mucus is to know genital diseases.

F.—Practical Application of Physiologic Phenomena Occurring in the Genital System

1.—Friedman's Test

FRIEDMAN'S test for the diagnosis of pregnancy is based upon the presence of a hormone from the anterior lobe of the hypophysis in the blood and urine during pregnancy. Since this is a test in which animals are used, and further since it requires a knowledge of ovarian cyclic changes in order to read it, it can be considered a field of great interest to the practicing veterinarian. It also happens that many small animal hospitals throughout the country are especially well equipped to handle rabbits in such a way that accurate readings may be made. It gives the veterinarian a contact with the medical profession that is very much to be desired and encouraged. I believe that every effort should be made to familiarize the other branch of the medical profession with the things the veterinarian is capable of doing. From experience I have found that the medical profession is very appreciative of such a service. Further, making Friedman tests for physicians may be a source of income to the veterinarian.

Technique.—Female rabbits not younger than 14 weeks should be used. It is probable that rabbits any age past 18 to 20 weeks can be used but there may be danger of ovulation from playing in the older ones. After a rest of a few weeks the rabbits can be used a second or third time, but if it decreases the accuracy of the diagnosis or increases the chances of error, only immature does should be used. They should be kept in cages by themselves following injection. White rabbits with big ears are easier to inject than small, dark colored breeds.

Morning urine should be used and filtered and 10cc injected while fresh. Why the hormone is in excess at this time need not to be discussed. One uses a glass Luerlok 10cc syringe with an 18-gauge, one-inch needle. A convenient restraint consists of a box just large enough to hold a rabbit. A cover that slides between grooves has a hole in one end through which the rabbit's ear can be drawn.

The ear should be shaved for a short distance over the marginal vein. If it is at all difficult to find, it can be dilated by thumping the ear and rubbing gently with alcohol. The needle is placed on the syringe before introducing it into the vein. It is pushed along the vein about ¼ inch and held in place by pinching the ear and needle between the thumb and finger. The warm urine is

slowly injected. If the rabbit squeals, one should stop for a few seconds and then proceed slowly.

Fig. 13.—Opened Abdomen of Rabbit showing engorged uterus due to effect of estrin and large corpora hemorrhagica on both ovaries. This is a typical illustration (except that the location of the fallopian tubes has been indicated by lines) of a positive reaction to Friedman's test for pregnancy 48 hours after the injection of 10cc of urine into the marginal vein of the ear. The engorged body and horns of the uterus are in sharp contrast with the lighter colored abdominal wall and the hemorrhagic corpora in the ovaries have the appearance of clots of blood.

The rabbit's ear is marked with an indelible pencil and punched with holes in order that no mistakes are made in identification. A card is placed on the outside of the cage, giving full information relative to the date of injection and when reading should be made.

Causes of Failure.—Death of the rabbits from the effects of the injection is uncommon. If the human patient has been taking quinine or other drugs in an effort to produce abortion the rabbit may die immediately following the injection. In such cases the physician should be notified and asked to procure another sample of urine, suggesting that the donor cooperate by providing a sample free from poisons. Of course, there are other causes of toxic urine but the rabbit usually survives more than 48 hours except in the case of drugs.

Interpreting the Reaction.—At the end of about 48 hours one can destroy the rabbit or perform a laparotomy and examine the ovaries and uterus. The ovaries of a normal, virgin rabbit at this age are pale and about the size of a grain of rice. They are filled with Graafian follicles not larger than a pinhead. Unless the urine is from a pregnant patient the ovaries remain unchanged. But if the urine is from a case of pregnancy the ovaries show marked changes. At about 24 hours the Graafian follicles are distended and ready to burst and by the 48th hour the ovaries contain several corpora hemorrhagica each of the size of a small grain of wheat. They are cherry red.

In all doubtful reactions the test should be repeated. If the rabbit dies after a 24-hour interval and the ovaries show a positive reaction the test need not be repeated, but if the test is negative, then it should be repeated since sufficient time has not elapsed to permit of a negative diagnosis.

Reports and Records.—In reporting the reaction to the physician it should be done by phone and later by letter, preserving a copy. The veterinarian should not take the name but only the initials of the patient and give the sample of urine a number at the time it is received and the physician notified of the number. This protects the veterinarian in a number of ways. In the first place he cannot be accused of spreading the news of a prospective visit of the stork since he does not know the name of the patient. Another feature to watch carefully is to report only the results of the test. Remember that the physician is making the diagnosis of

pregnancy, not the veterinarian. The former is guided by the results of the test, but he, and he alone, must assume the responsibility for the diagnosis.

Fig. 14.—Outside of Right Ear of Rabbit; Showing marginal Vein (indicated by arrow).

A record of all tests should be kept on file. The following is one form that is used.

Date	*No.*	*Physician*	*Patient*	*Last Period*	*History*	*React.*	*Report*
3-20-29	102	Cram (101W)	T. B. O.	1-10-29	28 yrs.	+	3-22-29
	103						
	104						
	105						

Test Unsuccessful in Cows.—It is very disappointing that up to the present time the Friedman test is of no value in the diagnosis of pregnancy in the cow. In spite of persistent effort on the part of numerous workers no solution of the problem is at hand. The urine of the cow is intensely toxic to the rabbit and even when so modified that large amounts can be used, still it does not carry enough hebin, (prolan A and B), to bring about a reaction.

Modified Test for Mares.—In the mare there exists a more favorable situation. Hart and Cole have given to the profession a practical and accurate method of diagnosing pregnancy in the mare. A full description of the method may be found in the *Journal American Veterinary Medical Association.*

A comparatively simple method consists in drawing 100cc of blood from the mare to be tested and allowing it to stand until serum separates from the clot. Ten cubic centimeters of serum is injected intravenously into the rabbit in the same manner as described for the Friedman test and the reaction is also read in the same way.

2.—Induction of Estrum

ESTRUM can be purposely induced by squeezing out the corpus luteum. Just what takes places as a result of the operation is not clearly understood. The sequence of events in the endocrine system that bring about estrum has been described. In addition to this it becomes necessary to discuss the production of estrum and ovulation through stimulation of the autonomic nervous system. In some animals—the rabbit among others—ovulation does not take place except at the time of copulation. This is probably not always true but is the usual case. At any rate, the impulse to ovulate originates in the nervous rather than the endocrine system. Another instance of the same nature is the case of estrum produced

in the female goat through teasing on the part of the male.

In the mare, estrum is encouraged by the presence of the stallion. Massage of the udder or breasts produces certain reactions in the genital tract, associated with the formation of mucus. Quoting from Cuillé and Chelle, (*Rev. Gén. Méd. Vét.*, Sept. 1932), Kraul has demonstrated to his satisfaction that ovulation can be induced by the stimulation of the parasympathetic and can be inhibited by the orthosympathetic systems.

This parallels the endocrine system, and acts in harmony with it. The exact relationship is not clear, nor is it certain that one can act independently of the other, although transplanted pieces of endocrine tissue produce the same effects as when they are supplied normally with their own blood vessels. According to the same writers, if guinea pigs or rats are injected with appropriate doses of pilocarpine (vago—or parasympathetic excitant) it accelerates the maturation of follicles, while on the contrary, adrenalin (exciting the orthosympathetic) arrests the formation of follicles and favors the development of the corpus luteum.

HOWEVER, at the present time I know of no other way of producing estrum in the cow other than that of squeezing out the corpus luteum. The indications for the operation fall into two groups, the first represents a more or less physiologic situation, while the second group includes conditions clearly of a pathologic nature.

At this time I prefer to discuss only those indications that apply to healthy individuals. For example, (1) when an aged cow producing a large or even a moderate quantity of milk fails to come in heat within a reasonable length of time following parturition, she can be made to do so by removing the corpus luteum from the ovary. (2) The date of estrum can be controlled. If, for any reason, it is desirable to breed a cow upon a certain date, then the operation can be depended upon to meet such a requirement. (3) If doubt exists relative to the occurrence of estral periods, as in the case of cows kept by themselves, one can make certain that estrum will take place within three to five days by removing the corpus luteum. Many other indications undoubtedly exist for the induction of estrum.

Technic for Pressing Out the Corpus Luteum of Pregnancy

THE operator and patient are prepared as for other examinations of the genital tract. No anesthesia is necessary. The ovary is located and held by the right hand in the rectum while the ovary is pressed upon by the left hand in the vagina. Pressure is applied at the base of the corpus luteum until the covering of the ovary splits and allows the lutein tissue to escape, leaving the thecal coats intact. One should keep the pressure confined to the base of the corpus luteum in order to avoid crushing it and also to prevent injury to the remaining Graafian follicles. If the operation is done skillfully, there will be only slight injury to the vaginal wall. Finger nails must be short to avoid scratching the mucous membranes. A rubber glove on the rectal hand affords protection to the operator as well as the rectal mucous membrane. The ovary is held by the hand in the rectum and the force applied by the hand in the vagina since the vaginal wall is much tougher than the rectal wall and injury to it is less serious than in case the rectum should either be penetrated or torn by a finger.

Hemorrhage

HEMORRHAGE is always more severe, I think, when the corpus luteum is pressed out than in the case of physiologic rupture of a Graafian follicle. Therefore, every possible precaution should be taken to prevent hemorrhage in excess. The thumb of the left hand should be held for several minutes in the crater made by the expressed corpus luteum. This brings pressure to bear upon bleeding mouths of capillaries and aids in checking the escape of blood. The operation should be avoided always in cows pasturing on sweet clover.

Close watch should be kept of the patient to determine the results of the operation. If after a few hours there is any sign of uneasiness the veterinarian should be notified and

a general examination made to locate its cause. Hemorrhage is suspected when the mucous membranes are pale, the temperature below 100°F., the pulse rapid and weak, respiration increased and gait uncertain. My experience with hemorrhage is limited to one case and that one was found dead the morning following the operation. My first thought would be to use a hemastatic solution in those cases where hemorrhage is diagnosed before the patient is weak. If the patient is staggering, then a laparotomy must be performed and the ovary ligated with catgut. I should not look forward to such an operation with equanimity since the peritoneal cavity would be filled with blood and the ovary surrounded by attempts at clot formation. I take every precaution possible to avoid such a catastrophe. In addition to a hemostatic solution one may give a blood transfusion. This is not difficult and should increase the coagulability of the patient's blood as well as replace some of that lost. The easiest way to draw and reinject blood is by means of a liter flask equipped with a cork and glass or metal tubes.

A 3/8-inch rubber hose is attached to each glass tube. A slip adapter is fastened in the end of each rubber hose. A 14-gauged needle is used to draw and administer the blood. A few crystals of sodium citrate are placed in the bottom of the flask, the needle slipped onto the adapter and introduced into the jugular of the donor. One then sucks on the short tube in order to create a vacuum and hasten the flow of blood. The flask is rotated to mix it with the citrate. In administering the blood one reverses the needle and blows into the flask to facilitate the flow into the vein of the recipient.

3.—Induction of Abortion

BY squeezing out the corpus luteum during the first period of gestation, that is prior to 90 to 120 days, the intentional induction of abortion in the cow can be brought about safely and easily without danger of introducing infection. The membranes loosen completely and are passed along with the fetus. The cow usually conceives at the following estral period. It is a far more simple problem than in the human subject, or in fact than in any animal other than the cow.

Indications for induction of abortion in the cow are: to prevent calving from accidental mating; where heifers are bred while too young and where cows are bred to undesirable bulls. I have not had occasion to induce abortion in very young animals. Because it is a one-handed task; the vagina and vulva being too small in young females to permit the use of a hand in the vagina to aid the hand in the rectum in pressing out the corpus luteum, one may find some difficulty in dislodging the yellow body. However, I think it can be done if attempted early in the gestation period, otherwise it should not be attempted at all.

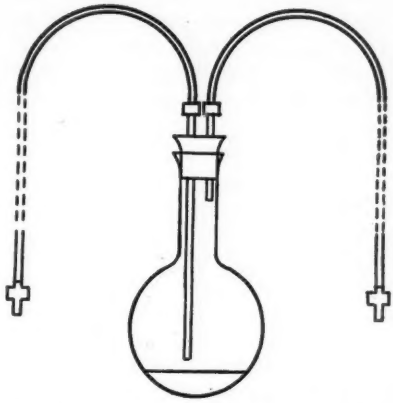


Fig. 15.—Blood Transfusion Apparatus.

Following the extirpation of the corpus luteum the fetus should be expelled within three to five days. The abortion is accompanied by signs of estrum on the part of the mother. In an attempted abortion sometimes the cervix fails to dilate, the fetal fluids escape; leaving the membranes hanging through the cervix and the fetus stranded within the uterus. A mummified fetus or possibly pyometra may result. Apparently this is not a frequent occurrence. If the fetus and its membranes lodge in the cervix they are removed usually without difficulty by moderate traction.

PART II—FUNCTIONAL STERILITY

FUNCTIONAL sterility is not altogether a satisfactory term but it may be taken to indicate those forms of interference with reproduction that are not due to inflammation or infection but are caused by a derangement of otherwise physiological processes.

The derangement may be due to: (1) hyper-production of one of the sex endocrine glands, as in the case of excessive production of estrin in cystic ovaries; (2) hypo-production; (3) inhibition of physiologic functions through the presence of endocrines that prevent the occurrence of normal sexual phenomena—retained corpus luteum; (4) absence of endocrine producing organs, due either to surgical removal, destruction by disease, or congenital aberration; (5) congenital defects that confuse the endocrine relationship—hermaphrodism; (6) the exhaustion of ova as the result of old age, or the rapid repetition of ovulation as the result of hyper-hypophyseal stimulation; (7) the influence of endocrines outside the immediate sexual chain—thyroid and adrenalin.

Directly associated with endocrine dysfunctions are nervous derangements, particularly the troubles that may be blamed upon the sympathetic system. Little enough is known about either one, so that when an effort made to understand a combination of the two, the veterinarian is tackling a difficult situation. There is sufficient proof that nervous excitation or inhibition causes functional sexual disturbance.

Too much or too little feed can be responsible for reproductive functional inactivities. Excessively fat animals commonly fail to conceive, while on the other hand thinness to the extent of emaciation does not often interfere with conception. The estral periods of the ewe can be encouraged by abundant feeding—flushing. The subject of nutrition—including vitamins A and E, adds a still more complicated angle to the already difficult problem of sterility.

Infection enters the picture as a secondary factor in functional sterility. It is highly probable that in most instances the two go hand in hand. It becomes a difficult problem to decide which one is the forerunner of the other. Lowered resistance on the part of mucous membranes due to the lack of vitamin A in the feed is characterized as a purulent discharge from the eyes, nose and vulva. That the rest of the genital tract takes part in the reaction there can be little doubt. In other words, infection of the genital tract is more likely to occur when its resistance is lowered by the absence of normal functions and lack of proper nutrition.

In the light of the foregoing discussion relative to the nervous and endocrine control of the female genitalia one may approach every-day problems of sterility and genital diseases with some degree of satisfaction. It has been shown that in the genital tract, physiologic phenomena may closely resemble pathologic changes. It must be understood that in many instances functional disturbances affecting the genital tract may present a clinical picture that is easily confused with pathologic conditions due to infection. In fact, our approach to the subject in the past has been through an effort to place too much emphasis upon infection and to neglect or misinterpret non-infectious conditions which may cause functional disturbances.

Outline of Part II

Endocrine and nervous disturbances in the reproductive system. In no other instance do physiological phenomena so closely resemble pathologic conditions. Hyperemia, congestion, swelling, nervousness, heat, and even swelling are of regular and normal occurrence in the genital tract and they are also the cardinal signs of inflammation.

A.—Hypophyseal Dysfunctions.
- Symptoms and diagnosis.
- Clinical evidence of hypo- and hyper-function.

B. —Ovarian Dysfunctions.
1. Nymphomania.
2. Unphysiologic Corpus Luteum.
3. Absence or premature atrophy of the corpus luteum.
4. Cystic Corpus luteum.
5. Non-functioning ovaries.

C.—Routine examination of the patient.

A.—Hypophyseal Dysfunctions

DUE in part to its hidden position, study of the pituitary body presents an extremely difficult problem. Until recently there has been little or no incentive to even think about it. But by one means or another—clinical observations and experimental transplantations of hypophyseal tissues—light has been thrown upon its function, so that, by a more or less roundabout way, one can with some assurance point to the hypophysis as taking part in functional irregularities that lead to failure in reproduction. Either failure to function, or on the other hand hyperactivity, on the part of some unit in the pituitary-ovarian relationship are responsible for ovarian dysfunction. (Refer to diagram on interrelationship, page 350.)

It is interesting to consider the organs that are most likely to be vulnerable in the chain of events extending from the production of the hormone in the anterior pituitary to its utilization by the ovary. To begin with, (1) the pituitary may not be producing the hormone which is essential for follicular maturation. (2) The pituitary production may be progressing normally but for some reason the hormone is not released into the blood stream. (3) The renal threshold may be lowered to such a degree that because of elimination the hormone is not available to the ovary in sufficient quantity to permit normal ovarian function. (4) The ovary may not be in a condition to receive the stimulus afforded by the hormone although the hormone be present in sufficient amount.

These facts, however, are of little satisfaction since we, as practicing veterinarians, are not yet in a position to determine the presence, or on the other hand, the lack of production of anterior-lobe hormone. But, knowing its function, we are in a position to conclude that certain hyperactivities as well as inactivities on the part of the ovary can be blamed upon the anterior hypophysis.

Keeping in mind Nelson's statement that "the hypophysis is the only gland that is fundamentally concerned with normal functioning of the gonads" one may be justified in considering any ovarian dysfunction as having its origin in, or at least being related to, hypophyseal disturbance.

IT may be stated now, and it will bear repeating later, that it is possible to observe a clinical syndrome, the characteristics of which point toward either a hypo- or a hyper-functioning organ (for example the ovary) because the characteristics exhibited in the symptom-complex are those in which the functions of that organ predominate. Further, it is the opinion of Zondek that endocrine diseases, in the majority of cases, are due not to pathological changes in single endocrine glands but must be looked upon as pluriglandular disturbances. Therefore, the veterinarian must give due consideration to functional interrelationships before placing responsibility for failure upon any single organ.

Veterinarians have been trying to treat ovarian dysfunctions as such, when as a matter of fact the condition is one in which more than one gland is involved and particularly is the hypophysis likely to be involved since it is fundamental.

We often speak of the antagonism and synergism that exists between certain glands. It may be better to call such actions stimulating and retarding since there really is no antagonism but rather a cooperative agreement between activity and rest unless some irregularity exists when the whole mechanism may be upset.

IN spite of the fact that any functional upheaval in any one gland of the system interferes with normal functioning in the remainder and involves them more or less in its tribulations (Hans Lisser), it becomes necessary to settle down to the study of individual glands and to let the pluriglandular influence take a secondary place in the picture. At present veterinarians do not recognize either physical or psychic disturbances that are known to belong to the hypophysis alone. Therefore, we are forced to base our suspicions of hypophyseal dysfunction upon related ovarian disturbances.

B.—Ovarian Dysfunctions

1.—Nymphomania

THE disease discussed under this heading is associated with cystic degeneration of the Graafian follicle and is encountered in females of many species but will be presented at this time with especial reference to the cow. It is characterized by an apparent effort to change from the female to the male. The manifestations of such a reversion are psychic, physical and glandular. The entire sexual equilibrium is deranged and a maniac syndrome is produced. W. L. Williams, the peer of all English writers on genital diseases in lower animals, makes this observation relative to nymphomania in cows. "Next to rabies, nymphomania in

Fig. 16.—A case of Cystic Ovary. The thick neck, masculine facial expression and the voice of a bull leaves no doubt as to the attempted change of sex.

cows is the most interesting scientifically and most important economically among diseases of animals characterized by notable mental aberrations."

Causes.—1. Infection as a probable cause of cystic degeneration of the Graafian follicle lacks convincing proof. There is no evidence of an inflammatory reaction and the fluid content is sterile.

2. Endocrine dysfunction lacks absolute confirmation, since it cannot be produced, consistently, experimentally. However, based upon our understanding of physiological processes one can construct a sound background for assuming that the condition is caused by a disturbed endocrine balance. In support of a hyper-hypophyseal—prolan A—stimulation one can cite the continual promotion of fluid production within the follicles. The impulse to function, whether nervous or endocrine, or both, continues while the ability of the Graafian follicles to burst and become luteinized is lacking. The persistent effort of impulses intended to bring about ovulation apparently have only the effect of stimulating the distension of follicles without being able to complete the normal chain of events. Let it be understood that the completion of the normal ovulation cycle includes the liberation of a mature, healthy, ovum.

In the case of cystic ovaries neither bursting nor ovulation take place. In fact, there is no ovum to escape even though the cyst be ruptured.

Whether or not the presence of the ovum in the follicle has an influence upon its maturation and bursting I am not prepared to say. It is worthy of study, however, since without the ovum, certainly, reproduction cannot occur. This must be borne in mind in the treatment and handling of cystic ovaries. For example, if some agent be used to produce ovulation, it is doomed to failure because of the absence of the most fundamental factor, the ovum.

FURTHER evidence, that endocrines are the cause of the disturbance, is not lacking, since the voice and physical characteristics are among the signs that point unmistakably to lack of normal endocrine control. A relationship between hypophyseal influence and metabolism may be seen in the occurrence of fractures, as a common sequence to cystic ovaries.

3. The relationship of minerals in the diet and vitamines has not been touched. The fact that only high-producing cows suffer from the disease leads one to observe that there is at least an enormous drain upon the calcium phosphorus content of the blood.

4. There is also no doubt but that nervous disturbances can cause development of ovarian cysts. If one interrupts the posterior communication to the ovary of a bitch by dividing the vessels, ligaments and presumably the nerve supply also, the ovary will become cystic but the cysts will not rupture,

neither will they luteinize. The bitch will show all the signs of estrin stimulation except menstruation. (I have not observed closely relative to the latter but I do not remember having seen blood in any of the cases although all other signs of heat were present.)

A physiologic foundation for suspecting the nervous system lies in well-known clinical examples of nervous influence upon ovulation. For instance, ovulation in the rabbit does not occur except during copulation. Secretion of mucus in the vagina can be produced by mammary massage although ovarian changes do not occur. Drugs acting through their effect upon the nervous system can bring about ovulation or inhibit it. (Kraul.)

Incidence.—Due to the fact that veterinarians seldom report their cases, and that nymphomania is a condition that is not recorded in slaughtered animals, there is no way to even estimate the frequency of its occurrence.

Gault described cystic ovaries in 1830 and the subject was discussed by Zangger in 1860. Since that time the problem has stood as a challenge to the veterinary profession. Cuillé and Chelle state that the immense majority of ovarian troubles in their region are due to two ovarian anomalies, namely, retained corpora lutea and cystic ovaries, and that of the two, cystic ovaries make up about 4%. Hess reverses the proportion to claim 90% for frequency of cysts. But probably he includes all cysts, while the matter at hand concerns only those associated with nymphomania.

Either there is a lack of uniformity in diagnosis, on the part of veterinarians, or in certain regions cystic ovaries are more common than in others. Some sections reporting 1% while in the neighborhood of Gers 30% to 40% of sterility cases are attributed to cysts. (Cuillé and Chelle.)

SO far as the United States is concerned, nymphomania occurs frequently in all sections. It is a menace to the dairy industry since it takes many of the best individuals. The fact that it constitutes a discouraging prospect so far as treatment is concerned must not deter investigation. On the contrary the profession accepts the challenge and proceeds to "dig out" and make use of all possible information relating to it.

Diagnosis.— The absolute necessity of an intimate knowledge of the ovary under all circumstances, including cyclic changes and pregnancy, has been sufficiently discussed and emphasized. One must consider history, symptoms, course, psychic and anatomical changes in arriving at a diagnosis. Anatomical changes can be divided into those affecting the ovary and those acting upon the body.

History.—When the veterinarian is forced to attempt an examination and diagnosis, without an accurate history of the individual and the herd from which it comes, he is thereby deprived of a most valuable asset. Records are an absolute necessity in handling sterility. The history of a nymphomaniac cow is to the effect that she has been a heavy milk producer and may still be giving a good flow. That the condition came on suddenly giving little or no warning of its approach. She is constantly in heat and may or may not stand for service.

Anatomical Changes in the Body.—Having obtained all relevant history one begins the examination of the case by observing the physical condition of the cow. One pays particular attention to the head, neck, pelvis and udder. One then proceeds with the examination of the genital tract. Beginning with the vulva one notes its size, color, firmness and shape. Normally the vulva of the cow attracts little attention. Its lips are thin, of a yellow color. But under the influence of estrin the vulva becomes edematous and firm rather than soft and elastic. This condition of the vulva is reflected in the rest of the genital tract. The cervix is flaccid and the uterus atonic. These factors increase the danger of infection. While the uterus does not fill with fluids it presents a chronic catarrhal picture. The mucus is of a catarrhal type. It never resembles mucus of estrum.

THE pelvis suffers the greatest injury in nymphomania of all body structures except the ovary itself. The sacro-iliac ligaments relax their hold and the bones move upon one another. The sacrum and coccygeal vertebrae ascend four and five to seven inches above their normal position. Following this distortion of the pelvis the deformity may be increased by fractures. These may involve the shaft or external angle of the ilium

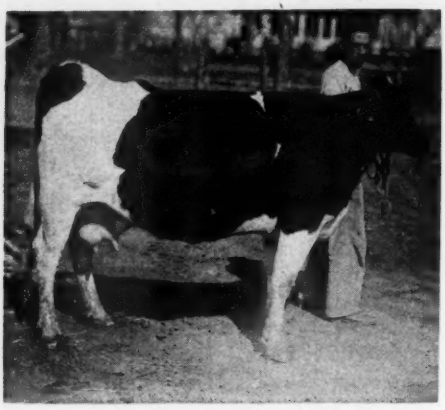


Fig. 17.—Fracture of the Pelvis. A part of the symptom-complex in nymphomania that leads one to suspect its relationship to those endocrines that influence calcium metabolism.

and cause varying degrees of deformity depending upon the location of the fracture. It is strange that under the circumstances such fractures heal. The cow remains more or less of a cripple but the pelvis regains at least part of its stability. During the healing process loud crepitations can be heard as the animal moves about. Some cases are so bad that one expects them to fall to pieces at any moment. Why the pelvis should be the only place where fractures occur is not explained. In fact one may only guess at the predisposing causes.

The work of Hart and others has shown to what an extent the skeleton may be depleted during the combined gestation and lactation periods. Under such attack upon the materials (especially lime and phosphorus) fractures are to be expected. However, the part played by the endocrine relationship has not been described. It is known that the hypophysis is a determining factor in metabolism. Probably the fractures and ligamentous relaxations are due to a combination of things that taken together subject the pelvis to unusual strain while in a weakened condition. It should be mentioned that the corpus luteum elaborates an endocrine called "relaxin" but in the absence of lutein tissue such a cause of relaxed pelvic ligaments is out of the picture.

Some of the physical changes are characterized by growths. The neck becomes thick, like that of a bull; the herdsman complains that the cow's stanchion is no longer wide enough for her. The facial expression for some reason becomes masculine. Just what modification in features brings about the change in appearance is not easy to detect but the male resemblance is there.

Changes in the Ovaries.—Macroscopic: The usual methods of rectal and vaginal examination are employed. The ovaries, because of their weight, may rest farther anteriorly than usual but they are easily found. One can pick them up with the hand in the rectum without difficulty. Using both hands for palpation one carefully examines the ovary and the tissues attached to it. With a little practice one learns to make reasonably close differentiations between the normal and the cystic Graafian follicle.

In approaching this subject a considerable space has been given to the description of normal conditions. In this discussion of the abnormal we begin to realize the value and necessity of such a foundation. Of course, in advanced cases the cysts are large and the general picture makes the diagnosis easy. However, the diagnosis of "cystic ovaries" is too frequently loosely made; it should be concluded only after a complete summary of all factors concerned. One finds the cyst to be larger than a marble (more than one centimeter in diameter). Rubeli states that ova are not found in follicles—cysts—that exceed 1.5cm. (3/5-inch) in diameter.

Both ovaries are nearly alike, pointing toward a systemic causative agent, acting possibly through the blood stream or nervous system rather than a local irritant. Fluid

may accumulate within the cyst until it attains the size of an orange. There is usually not more than one cyst on each ovary although two or more are sometimes found. Or rather one cyst is occasionally multilocular. The surface is round and smooth and when larger than a grape fluctuation can be detected, although not to a marked degree because of the tenseness of its surface. The wall of the cyst varies somewhat in thickness but usually it is so thin that moderate pressure with the hands causes it to give way —burst.

I AM of the opinion that those cysts that cannot be broken by moderate pressures are likely to be of more of a chronic inflammatory nature. That is, for some reason the thecal walls have become thick as if responding to a mild irritant. Such walls are not easily ruptured. It is also believed that *such* cysts contain lutein tissue. This opinion is based upon the character of the ruptured wall (when rupture is possible), through the examination of many so-called "packing house specimens" and from the kind of yellow fluid obtained upon aspiration through the vaginal wall.

The bursting of the cyst reduces the size of the ovary to that of a hazel-nut or smaller.

At the end of two weeks following the rupture of a cyst, either another forms, or else the ruptured wall repairs and the same cyst refills. There are no adhesions surrounding this type of cystic ovaries. This fact alone nearly discounts the possibility of the cause being of an inflammatory origin. It is a routine part of the examination of every case to hold the ovary in the hand in the vagina while the fingers of the right hand search for the loose peritoneal pocket that only partly surrounds the ovary of the cow and holds in its walls the thin strands of mucous membrane that form the pavilion of the fallopian tube and its mouth (ostium). If the fingers can enter the pocket and by spreading them apart the peritoneal sac is found to open without embarrassment, then one can assume that the fallopian tube, as well as the ovary, are free from external adhesions. Further, one must conclude that the distention of the cyst is due to factors foreign to infection and inflammation.

One passes the fingers carefully over the surface of the ovary to determine if possible to what extent ovarian tissue may be left unaltered. Ovarian tissue is detected by its firmness and by its nodular "feeling" due to the presence of Graafian follicles. Of course, one cannot differentiate between cysts and follicles by rectal and vaginal palpation. But

Fig. 18.—Cystic Ovary and Uterus. The wall of the uterus is incised to show its atonic character.

there is something that comes through the sense of touch that is characteristic of healthy tissue. The opposite situation is also true, that is, by palpation one learns to detect slight changes in size, shape, contour, firmness and fluctuation that point toward—indicate—the abnormal.

As already stated, *size* is a more or less determining factor but the difficulty lies in the fact that the difference between a Graafian follicle and a cyst is histologic regardless of size. True, large cysts are always pathologic but small cysts also may be lacking in the same histologic structures. So it follows, that while size is important to consider, it is only one of many factors.

The *shape* of the cyst becomes spherical as it increases in size. Graafian follicles are always round but comparatively large cysts

may be oblong. If a cyst is multilocular it takes on a more or less lobulated contour.

IF ONE encounters a situation in which the history and symptoms, including psychic phenomena point toward the presence of cysts but upon ovarian examination one finds difficulty in differentiating follicles from cysts pressure may be applied. If it ruptures easily one may still be in doubt but if it ruptures with difficulty or reveals

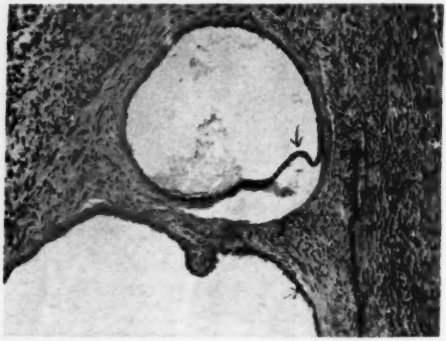


Fig. 19.—Cystic Degeneration of Graafian Follicle (microscopic section). Note the single layer of epithelial cells lining the Cyst; representing what is left of the Granulosa. This is important since it serves to identify the Cyst as being of Graafian Follicle origin. (Feldman.)

a thick wall upon rupture then one is certain it is not a Graafian follicle.

Graafian follicles ripen one (seldom more) at a time; therefore the presence of more than one follicle, including both ovaries, leads one to suspect cysts rather than follicles.

The following situation is an important one to recognize since it leads to fairly accurate conclusions.

"If the yellow body of the last estral period is relatively large, only slightly receding, and without pathologic changes, no grounds can be taken for a disturbed ovarian cycle nor an explanation made for the presence of cysts. On the other hand if the ovaries contain only greatly reduced corpora lutea one can correctly assume that ovulation is disturbed and the presence of follicles is indicative of cystic degeneration." (Walter Frei).

Every veterinarian engaged in work with sterility should commit to memory the above statement since it is most helpful in the diagnosis of ovarian troubles.

Graafian follicles may reach the size of maturity (larger than 1cm) in either or both ovaries during pregnancy and of course in the presence of a corpus luteum. However, it is interesting to observe that the stimulus to rupture is held in abeyance.

Psychic Aberrations.—The mental attitude is that to be expected in animals during estrum in addition to certain actions that are characteristic of the male. For example it is not uncommon to see a cow kneel and rub her head in the dirt as if she had big horns and massive neck. I think this is strictly a male bovine custom adopted by nymphomaniac cows. They are also seen to turn up the lip and elevate the head as if testing an odor. This is also a masculine trait.

Such cows have advanced information relative to approaching estrum in other cows. It is common to see them following cows around that are not in heat but 24 to 48 hours later show the first signs. Probably a bull could make such an early discovery but surely not far ahead of it. Mounting, bellowing and pawing is a part of the picture.

Microscopic Picture.—It is not the intention, at this time, to ask the practitioner to study, more than in slight detail, the microscopic picture of the ovary. It is intensely interesting and very important, however, since the outcome of the case depends upon the presence or absence of conditions that can be learned only upon microscopic study; later perhaps to be recognized because of the gross lesion that follows those microscopic changes.

The theca varies in thickness and density. In many instances there remains a very thin layer of lutein tissue and the fluid contents may be stained yellow. The presence of lutein tissue serves to blur the clinical picture. Unless one has a history of the case one can only guess at the significance of the lutein tissue. In those cases of my experience where a definite history is known and the ovaries were obtained for sectioning there was no sign of either

lutein tissue in the cyst or in any other part of the ovaries.

In the microscopic examination of a large cyst one finds that the granulosa has entirely disappeared except a thin single layer of epithelial cells. The rest of the wall is connective tissue. However, it is of significance to find epithelium present since it serves to identify the cyst as of follicular origin.

IT IS not uncommon to find large cysts lined with lutein tissue. But in my experience such instances have been in ovaries obtained from the packing house where history of the case was not obtained. In those cases where the ovaries were from known nymphomaniac cows, no lutein tissue was to be found in the ovary. I am of the opinion that cysts of the type that are associated with the nymphomaniac syndrome are not of true Graafian follicle origin, but come from atretic follicles. The time of death and disappearance of the ovum and granulosa of course is not known. Not only is there an absence of lutein tissue throughout the ovary but there are no ova. All remaining follicles are atretic. This is a broad statement and one should qualify it by saying that none could be found upon careful search of sections made at frequent intervals.

In ovaries, where there is some glandular tissue left, a few ova can be found but they do not have a vigorous appearance; being held by a small cumulus of cells more or less separated from the rest of a rather thin granulosa. The wall of the cyst is almost devoid of blood vessels and while the theca is of connective tissue there is nothing about the picture either macroscopic or microscopic that would lead to the suggestion of inflammatory origin. The absence of ova from all parts of the ovary is of great clinical interest. If in any case should all the ova have perished, the case immediately becomes hopeless so far as reproduction is concerned. It would therefore be of great clinical significance if one were able to determine the presence or absence of normal Graafian follicles. Further discussion of this problem will be undertaken in diagnosis.

The chemical analysis of the fluid contents of the cyst offers little of clinical value. It is alkaline, straw-colored. According to Wester, cystic fluids are 3.5% albumin, while normal follicular fluid is 5.5%. This also is contrary to what might be expected in an inflammatory process. The fluid has the properties of a transudate. Injected into spayed rats it does not create a reaction in the vaginal mucous membrane that would indicate the presence of estrin. This statement is based upon 12 trials. In a few cases nucleated epithelial cells became more numerous than usual, but never have I seen a satisfactory, positive reaction following its injection. If this proves to be the case, then why is the estrin syndrome so much in evidence? Or admitting that the clinical picture is one that could be produced by continual over-stimulation by estrin, what is its source?

Handling.—The endocrine system is undoubtedly at fault in this trying disease, and there appear to be some fundamental changes that cannot be corrected. It is my opinion—and this is supported by a number of references—that the death of the ovum is a part of the lesion in cystic ovaries and it is to be feared that this is not only the case in certain sections of the gland but that for some reason both ovaries are almost entirely devoid of ova. The prognosis in such a case is hopeless. Unfortunately our clinical experience indicates that in nymphomania we are faced with a very discouraging situation. After a very thorough review of the field, Cuillé and Chelle make this statement: "Nymphomaniac cows are always sterile."

There are few exceptions to this rule; however, if cared for during the early periods of the disease a few cases can be saved, at least for one breeding period.

FREQUENT rupture of the cysts brings about marked improvement in favorable cases. The cow loses interest in animals that are in heat, the voice loses its "bellow," the appetite improves, she gains in weight and the pelvis returns to nearly normal except where fractures have caused permanent deformity.

W. L. Williams reports several instances in which valuable cows have been saved by treatment. If the cyst resists moderate pres-

sure, then a large, hollow needle may be pushed through the vaginal wall into the ovary held in the hand in the rectum. There is little danger associated with the operation. The vagina should be flushed with warm water and the external pudenda scrubbed with soap and water. The operator should prepare himself by a thorough cleansing with soap and water and alcohol. The needle must be sterile. I have found it awkward to carry a sharp-pointed needle into the vagina and handle it there with one hand. It is much easier to tie the needle and tubing to a metal rod that can be managed through the aid of an assistant while the needle is guided by the operator. One must avoid puncturing coils of the rectum. Other viscera are not likely to be in the field. If one chooses one can use the guarded knife designed by Williams instead of a canula. If the fluid is to be examined to determine its properties it can be saved by attaching rubber tubing onto the canula and collecting the fluid in a bottle. Tests are of little practical value. Injected into spayed rats one can differentiate between true follicular fluid and cystic transudate. A yellowish color points to the presence of lutein lining.

Dykstra reports very favorable results from the evacuation of cysts in sterile mares. If either bursting or puncture does not give relief then one must resort to castration.

Since both ovaries are usually affected nothing can be gained from the ablation of one ovary. However, if one should encounter a case in which the lesions are confined to one ovary then unilateral ovariotomy should be resorted to immediately.

Ovariotomy is best performed through the vaginal wall under epidural anesthesia and in the standing position.

2.—The Unphysiologic Corpus Luteum—The Retained Corpus Luteum of Muco-Metra

IT MAY be assumed that if the corpus luteum is unphysiologic then it certainly should be pathologic. I have chosen such a term because I wished to infer that it is possible for a governing body such as the corpus luteum to assume a rôle that is not physiologic, without in any way changing its histologic structure. With this explanation, I accept the criticism of possible inconsistency and allow the term "unphysiologic" to remain.

The factors surrounding the formation of the physiologic corpus luteum have been discussed and need not be repeated at this time except to say that its formation is dependent upon endocrines of the hypophysis and the sympathetic nervous system. (See chart.) Also that the presence of the ovum is necessary to the formation of a corpus luteum is accepted without further discussion. Further it is interesting to note that even after the escape of the ovum from the follicle it still either directly or indirectly governs the course of the corpus luteum. If fertilization and pregnancy occur, the corpus luteum remains stationary, changing only in shape and color. If the ovum does not mate with a sperm, then the corpus luteum atrophies and another takes its place. This program can be interrupted only by pregnancy, some disturbance on the part of the endocrine chain, or the complete exhaustion of the supply of ova. The normal tissue of a corpus luteum is dependent, not only upon the presence of a fertilized ovum, but also upon the course the ovum pursues following fertilization. Whether or not death of the ovum prior to the growth and rupture of a follicle is a determining factor may be clouded by lack of adequate proof. But in regard to its influence following fertilization there can be no doubt.

FOLLOWING fertilization the placenta establishes its relationship with the corpus luteum. We know that the placenta in some way inhibits the regression of the corpus luteum. It is also known that the placenta is a storehouse for estrin. So it is presumed that the action of the placenta upon the corpus luteum is really the effect of estrin. However, there is another force to consider, namely, the autonomic nervous system. Clinical evidence appears to indicate that impulses originating from the endometrium may in some way affect the corpus

luteum. To further confuse the picture, both exciting and depressing nervous influences can occur. The inhibiting impulses are carried through the orthosympathetic and the exciting impulses through the para- or vagosympathetic systems. In the rabbit, copulation brings about ovulation. There is some suspicion that irritating the cervix of the cow or mare by introducing the finger or instruments may bring about ovulation. In fact, up to recent years this, to the veterinary profession, as well as to animal husbandry, was the only known treatment for sterility.

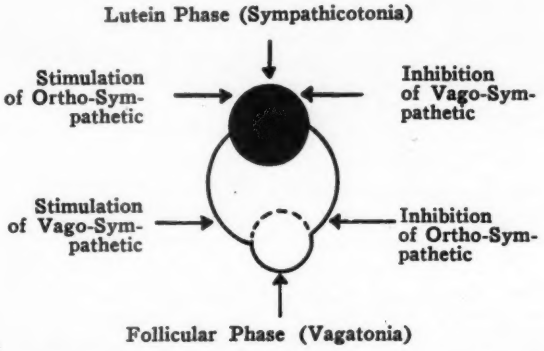


Fig. 20.—Relationship of the Influence of the Nervous and Endocrine systems upon the ovary.—The facts surrounding the situation are not altogether clear, and when one considers that nerves controlling certain functions can be either stimulated or inhibited, the picture becomes more or less complicated.

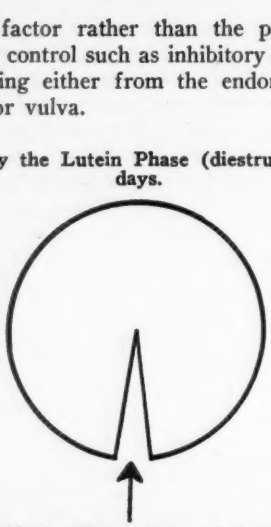
By stimulating the ortho-sympathetic system luteinization is encouraged, by inhibiting the same system, follicle formation is promoted.

Therefore the excitation of the vago system reverses the equilibrium of the ortho-sympathetic and transforms sympathicotonia (lutein phase) into a vagotonia (follicular phase). It provokes the disappearance of the corpus luteum and the development of the primary follicle. It is the excitation of the parasympathetic system that explains the good results obtained through the treatment of sterility by mechanical means." (Cuillé and Chelle, Rev. Gén. Vét. Méd. Sept. 1932, p. 558.)

SIMULATING the effect of estrin and the placenta upon the hypophysis and therefore upon the corpus luteum, there are many clinical examples of the inhibitory effect of nervous impulses originating in the genital tract. If for instance, estrum is held in abeyance by foreign bodies in the uterus, such as the bones of a dessicated fetus, deceptive impulses are carried to the centers controlling the corpus luteum so that instead of being expelled, the forces that would ordinarily cause evacuation are restrained and the bones lie in the uterus indefinitely. Shot placed in the uterus or vagina of a bitch prevent the occurrence of estrum. The presence of fluid in the uterus acts in the same way as a foreign body, that is by producing a sedative effect upon the corpus luteum, thereby inhibiting the evacuation of the uterine contents. The difficulty lies in the fact that there is no way of telling which way the inhibitory impulses are running. That is, the uterus may lie dormant because the corpus luteum does not move or th opposite prevail—the corpus luteum does not change because of the nervous-inhibitory influence upon the ovary that originates in the endometrium. Both situations are possible at the same time but it is important that the clinician should be informed relative to the facts when it comes to treatment. To evacuate the uterus without removing the retained corpus luteum, is of little or no benefit but to press out the corpus luteum sets into action a concert of phenomena that brings about permanent health. It would seem then that the corpus luteum is the gov-

erning factor rather than the peripheral nervous control such as inhibitory impulses originating either from the endometrium, cervix or vulva.

Normally the Lutein Phase (diestrum) is 21 days.



The Follicular Phase (estrum) is 6 hours.
Fig. 21.—Graphic Comparison as to length of Lutein and Follicular phases of Estral Cycle.

In addition to its restraining influence the corpus luteum stimulates the production of mucus within the uterus, since that is one of its physiologic duties.

IF FOR some reason, either nervous or endocrine, the corpus luteum of estrum or pregnancy should fail to atrophy, although the uterus is non-gravid and there exists no placental influence, then the corpus luteum continues stimulating the flow of mucus into the uterus and at the same time prevents its escape through inhibition of evacuation. The result is muco-metra. The uterus becomes distended with fluid and one's first thought is that one is dealing with pregnancy. The fact that the uterus may have recently been gravid may have left the blood vessels that supply it larger than one would expect to find in a non-gravid case. Of course they lack the life and activity of vessels feeding a pregnant uterus but at the same time they may confuse even an experienced operator. The walls of the uterus in muco-metra are thin and fluctuating. They differ only slightly from the gravid uterus. One observes that they are equally distended throughout their entire length and are nearly symmetrical. In pregnancy the gravid horn tapers anteriorly. In either instance it hangs well over the pelvic brim. Whether or not it can be lifted depends upon the quantity of mucus it contains. In most cases it does not retain large quantities. The uterus still appears to maintain some reactive power and evacuates part of its contents. This being the case the diagnosis becomes less difficult because of the presence of discharge.

However, the cervix sometimes remains closed and the seal is not different from that of pregnancy. It is tenacious, straw colored, and completely closes the lumen. Remember that this is not a case complicated by infection and a healthy but inactive cervix allows the mucus to remain undisturbed. Without accurate and dependable history, such cases are frequently very trying.

Cuillé and Chelle also state that at least in many instances the accumulating mucus remains sterile. This is important since it is the toxins of organisms that destroy endometrium while in the case of sterile or nearly sterile mucus the effect upon the endometrium is one of more or less maceration but not destruction. The proof of this lies in the fact that upon the dislodgement of the corpus luteum the uterus is evacuated and returns to normal. I have seen this occur many times although the accumulated fluid was yellow and had all the appearance of pus. Either the injury in those cases was not great, permitting complete and rapid repair to take place, or else the mucus was actually sterile due in part at least to the presence of active leucocytes. I believe that a case report at this time is of sufficient interest to warrant relating it.

I WAS once called upon to care for a cow in which there was an accumulation of muco-purulent fluid in the uterus. It was not the first of its kind that I had seen but at the time I did not know what to expect from squeezing out of the corpus luteum as a part of the treatment. The minister to whom the cow belonged was told that the prognosis was very unfavorable and that she would not calve again. This opinion was based upon experience with a number of

similar cases. The instance was forgotten and a year passed. One day on the street a more or less irate minister told me that he had parted with the cow because of my unfavorable prognosis and that now she was the mother of twins. The news to me was embarrassing enough but the lesson gained from the experience was that one should not be too hasty in giving prognosis, in the case of muco-metra, since many such cases make complete and early recoveries.

The retained corpus luteum resembles that of estrum and pregnancy in that it is superficially located, not firmly attached to the ovary, and can be removed without difficulty.

Walter Frei states that the anomaly is not anatomical but functional, since the histology of a persistent corpus luteum is not different from a corpus luteum of pregnancy. At least in most instances one can not differentiate between the two by rectal and vaginal palpation. A differentiation is made by a correlation of associated factors.

The syndrome also differs sharply from that seen in cystic, embedded, and indurated and adherent corpora lutea since in the latter diseases, except in the case of cystic ovaries, inflammatory changes combine with functional disturbance to complicate the picture.

ALL through this discussion, the close resemblance of pathologic changes to physiologic phenomena has been emphasized. The resemblance of the retained corpus luteum and the similarity of muco-metra to the uterus of early gestation are sources of confusion that prove difficult in anyone's experience. Further it must be remembered that there are several different clinical syndromes surrounding retained corpora lutea, and that the prognosis and handling depends upon the early recognition of the different situations and conditions.

The type of retained corpus luteum I wish to discuss has not undergone tissue change either cystic, indurative or encapsulative. The corpus luteum associated with the latter conditions may be related to inflammation. The corpus luteum of muco-metra is not. The cause is functional and therefore related to the subject at hand, "functional sterility." While the causes of retained corpus luteum are not definitely explained the circumstances accompanying its persistence are well known.

History of Retained Corpus Luteum of Muco-Metra

THE history of such a case is that of normal parturition, which may or may not have been followed by one or more estral periods. Then no further evidence of estrum appeared. At irregular intervals a quantity of muco-purulent material escaped from the vulva. As already stated, the few organisms that may have been present were completely phagocytized and the fluid remained sterile. There is no doubt that infection sometimes plays a part but it is also true that actual inflammatory changes either within or in immediate contact with the ovary are not often observed. It is not the purpose of this paper to discuss any condition the cause of which may be laid to infection.

There may be a complete absence of exudate and the uterus is found to be flabby but nearly empty. The duration has not exceeded a few months. It is hoped that the condition has been so clearly described that a diagnosis can be made without confusion relative to other more serious conditions that follow retained corpus luteum. Further that the prognosis in this case is nearly always favorable. Cuillé and Chelle report Janote as having treated 2,000 cases of similar nature with 75% recoveries upon one treatment and most of the remaining 25% upon a second handling.

Treatment of Muco-Metra.—The adoption of nature's own methods to bring into action a series of physiologic phenomena intended to overcome an injury is not an uncommon therapeutic measure. For example the application of heat to an infected area excites the reactive processes of the body which immediately combat the infection, not by the direct action of the irritant but through promotion of forces resting within the tissues themselves, thereby using the means at hand to combat an injury. The phenomena set in motion through the man-

ual extirpation of the corpus luteum is also a physiologic process, unique in that no external stimulus is necessary, only the liberation of a part of the ovary, as if one would pull a pin or switch and allow an electric current to start rolling the wheels of a most intricate piece of machinery. Thus by holding the ovary in one hand and pressing out the corpus luteum with the other (vaginal) hand one makes use of one of the most phenomenal surgico-physiologic measures known to the profession. A reaction takes place. Blood is attracted to the genital system along with all of its defensive and reparative properties. The entire mucous surface is lavaged and subjected to a freshening that removes all residual debris and leaves the uterus in a healthy, receptive condition.

Signs of true estrum appear in a few days following the operation and the uterus is completely evacuated. The yellow mucus is discharged and a clear mucus of estrum in normal quantity takes its place. Although pituitrin has the property of stimulating uterine contractions, it is not often employed in the relief of sterility. Possibly it has been neglected in therapeutic measure but one reason it has not been more frequently used is that in such cases as the one under consideration it is not needed.

AT THE present time none of the endocrine or chemical agents are of therapeutic value in the treatment of ovarian, and subsequently uterine, dysfunctions. Favorable results, following uterine injections of various antiseptics are reported but it is still my opinion that they are of little value so long as the incumbent corpus luteum remains undisturbed. Others are of the opinion that such injections bring about favorable results through the influence of the para-sympathetic system and its promotion of a new ovulation. All efforts to bring about such an action have failed in my experience. Further it is claimed that an energetic "badigeonnage" with the knuckles or stimulation by opening the cervix, will cause estrum. Because this may be true, in the diagnosis of pregnancy I have taken extra-precaution in the vaginal examination of cows that might be with calf. In no instance have I any reason to believe that I have caused abortion by such procedure.

If muco-metra is allowed to go untreated, infection may gain the ascendency and be

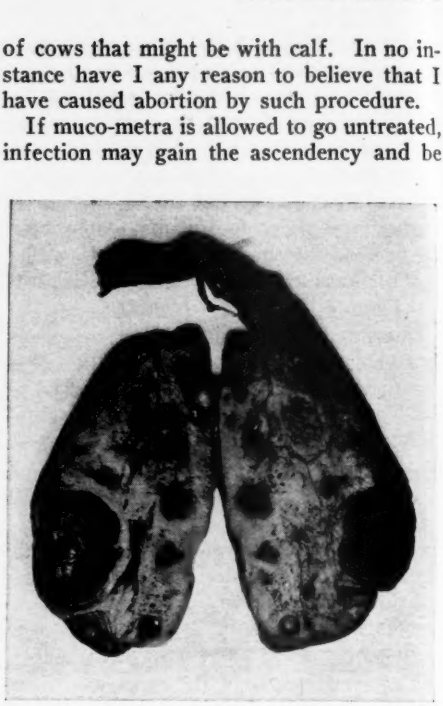


Fig. 22.—Retained Corpus Luteum with small cyst in the center and connective tissue capsule around its periphery. It is best to remove the entire ovary in such cases.

followed by irreparable destruction of mucus membranes.

Endometritis is not included in this discussion although retained corpus luteum becomes a secondary factor in many infections of the uterus. The same applies to mummified or macerating fetuses. The corpus luteum and its endocrine relationships must be considered in the handling. In cases of long standing the corpus luteum may become cystic and encapsulated by a layer of connective tissue. I have performed laparotomy and surgically removed such bodies but for some reason the benefits were short lived and the condition immediately recurred. In those cases where only one side was involved I have removed the whole ovary with very satisfactory results. Upon getting rid of the offending gland and its corpus luteum the other ovary resumed its function and the cow reproduced normally.

3.—Dysfunctions Incident to Absence or Premature Atrophy of the Corpus Luteum

IT MAY be odd to lay trouble at the door of a body that is not even present, but it so happens that when that body is the corpus luteum its absence can be responsible for serious difficulties.

Of course one does not expect to find a corpus luteum upon the ovary of a heifer prior to the occurrence of estrum, but once estrum has taken place then the corpus luteum must always be present either upon one ovary or the other. The only exception to this is dysfunction or disease.

Lutein tissue must be present in varying amounts at all times in normal ovaries, and since it has a definite function to perform its absence is manifested by a certain derangement of endocrine control.

Two abnormal conditions already described are associated with the absence of the corpus luteum: First the condition associated with nonfunctioning ovaries, because in that case there are no follicles to precede the corpus luteum. In the second instance follicles form but do not ripen and burst. This is the forerunner of cystic ovaries and nymphomania. Therefore one loses sight of the lutein factor because of the predominance of the exciting agencies (vagotonia). The fact remains, however, that it is the lack of lutein tissue that permits nymphomania to take place.

The loss of a corpus luteum by any means —mechanical, nervous, or nutritional—can be responsible for very serious sequellae.

In Part I, under the discussion of physiologic processes, it was made clear that if one chooses one can safely and easily produce abortion early in the period of gestation by squeezing out the corpus luteum of pregnancy.

IT IS appropriate therefore that one should consider seriously the possibility of abortion occurring through the accidental or unintentional disturbance of the corpus luteum. W. L. Boyd and others have observed cases of abortion in which the corpus luteum was greatly atrophied. The influences surrounding such a situation are not clear but in considering the problem of abortion, after the elimination of infectious causes, the part taken by the corpus luteum must be given attention. Along this line one turns to the probability of nervous influence upon the genital system. It may be possible that indirectly the stimulation of the vagina, through examination or copulation, could excite the anterior hypophysis to such an extent that ovarium function might be set in motion resulting in the induction of estrum and the evacuation of the uterus (vagotonia). At any rate one proceeds with vaginal examination with great precaution and avoids prolonged abuse. Estrum during pregnancy is not uncommon. This must be accompanied by an open cervix and a stormy time for the fetus already present in the uterus. Fertilization of a second ovum with nidation can take place. It is observed in the mare and is usually followed by abortion of both fetuses. This is called superfetation and is uncommon in the cow.

4.—Cystic Corpus Luteum

INSTEAD of a corpus luteum developing in the normal manner it is possible for lutein tissue to form inside an unruptured follicle and so long as it remains, estrum does not appear. I do not believe that luteinization progresses far in such follicles but that lutein formation is soon arrested unless the follicle bursts and liberates its fluid contents.

Cysts containing lutein tissue are frequently found but not always under circumstances that enable one to draw accurate conclusions. For instance in uteri obtained from the packing houses one cannot get the history of the case and where cysts are encountered in the ovaries of live animals one cannot be sure of the presence or absence of lutein tissue unless it is present in comparatively large amounts. My experience leads me to believe that lutein tissue does not form in macroscopic amounts except in follicles that have burst. So that the presence of a corpus luteum at least indicates a power to rupture on the part of the follicles no matter what becomes of the corpus

luteum after it is formed. I also believe that the presence of a corpus luteum indicates that an ovum was there at the time of rupture of the follicle. And that other ova exist in remaining follicles. This is an entirely different situation from nymphomania in which no ova are present and no lutein tissue is found within the cysts.

Walter Frei in discussing the difference of opinion between Williams and Krupski

Fig. 23.—Upset in Endocrine-Nervous Control. 1. The hypophysis; 2. the left ovary with retained corpus luteum; 3. a 20-inch section of membrane, apparantly the allantois from which all fluids have escaped; 4. a cyst that may be the remains of the amniotic sac since it contained an amorphous mass of about the size of a grain of wheat. The other ovary (right) contained a cyst about 3 inches in diameter containing 125c.c. of straw-colored fluid. Repeated efforts by rat tests failed to detect the presence of estrin in the fluid.

This case is reported as an illustration of the kind of problem with which the veterinarian is commonly confronted.. It serves as an example of an upset in endocrine-nervous control.

The first interpretation would be that for some reason the fertilized ovum had perished. Being aseptic its fluids were absorbed without putrification. Remaining in the uterus, it exerted an inhibitory (orthosympathetic) influence upon the hypophysis preventing ovarian stimulation and subsequent uterine evacuation. Therefore the corpus luteum remained and as time went on it became more or less embedded but did not undergo cystic changes. Apparently an effort from some source was being made to bring about ovarian function since there were large cysts that may have been Graafian follicles, lacking the impulse to rupture the follicles continued to increase in size and finally themselves became cystic. It is common to find large Graafian follicles in the presence of the corpus luteum of pregnancy, but one does not frequently encounter large cysts and a substantial corpus luteum present at the same time.

The keystone of the situation lay in the corpus luteum. But in order to obtain relief through its removal normal Graafian follicles must have been present. The removal of the retained corpus luteum might have allowed the ripening of a follicle and subsequent uterine evacuation, but in the absence of ova, treatment would have been of no avail.

believes that a lutein cyst can eventually through complete absorption of lutein tissue become a "nymphomaniac" cyst. This is undoubtedly true but back of the whole trouble lies the absence of ova.

The immediate causes of cystic degeneration of the corpus luteum are not known. Age may be a factor but there also may be something else, since the corpus luteum of pregnancy remains almost unchanged and even the retained corpus luteum of mucometra stays about the same for months and does not become cystic.

INFLAMMATORY conditions surrounding the ovary—pavilionitis—are commonly accompanied by cystic ovary. This leads W. L. Williams to infer that infection plays a major rôle. He also emphasizes the fact that since salpingitis is incurable, and the two are commonly found together, then the prognosis of cystic corpus luteum becomes very grave. Regardless of the association of infection the prognosis of cystic corpus luteum is never favorable. It is difficult to remove and for some reason enucleation does not relieve the condition. If one ovary only is involved, which is infrequently the case, unilateral ovariotomy is in order. Any other treatment is a waste of time.

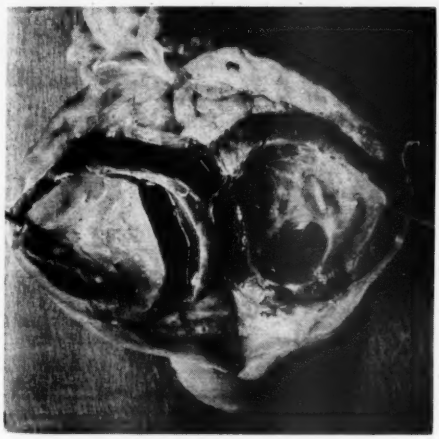


Fig. 24.—Cystic Degeneration of the Corpus Luteum. It will be noted that although the thecal wall is thick, the remainder of the ovary is free from adhesions and the fallopian tube is patent.

5.—Non-Functioning Ovaries

THIS refers to an endocrine dysfunction characterized by inactivity on the part of those phenomena that depend upon the ovaries for their initiation and perpetuation. A lack of endocrine influence.

Normally the ovaries do not function, sexually, prior to puberty nor during extreme old age. The menopause, however, is not observed in animals as it is in the human subject. If animals were more frequently allowed to reach old age some definite information could be obtained relative to the time of menopause—the period when menstruation ceases permanently. But, under conditions as they now exist, the life of an animal is not prolonged beyond the period of its usefulness.

Disease of some sort usually ends the reproductive period of a cow before the age of senility is reached. However, there are occasionally instances where because of the value of their progeny cows are kept so long as there is any chance that they may conceive and give birth to a calf. Their heat periods are irregular and the rest of the genital tract more or less atonic. The ovaries are not atrophied but are usually larger than when they were young, due to the accumulation of connective tissue and scars left from atrophied corpora albicans; there is also an increase in size of atretic follicles.

Both groups—extremes of young and old—might be included in discussion of non-functioning ovaries. But our interest is directed toward those cases where normally they should be active but are not.

NON-FUNCTIONING ovaries present the following clinical picture. The ovaries are small, equal in size and of firm consistency. They contain neither corpora lutea nor palpable Graafian follicles. A few small nodules can be felt in the periphery of one or both ovaries. There are no recognizable pathological changes. The ovaries and tubes are free from adhesions or other signs of inflammation. The rest of the genital tract remains normal and there are not sufficient changes in the mucus to attract attention.

We have no reliable information upon such so-called non-functioning ovaries. The condition as such does not exist for any great length of time. Either the ovaries return to normal or are sacrificed to some pathological change.

STERILITY without demonstrable cause is of common occurrence in heifers. Notwithstanding the presence of estrum the ovaries are found to be small and without corpora lutea or large Graafian follicles. Such a condition is not easily explained. In fact, I have been reluctant to believe that such a condition might exist. However, I have repeatedly encountered just that sort of thing and reports of other veterinarians lead me to suspect that estrum in some instances can take place without ovulation. Estrum, or at least signs that resemble estrum, are a part of the picture of cystic ovaries although ovulation does not occur. This example is one reason for making me think it may be possible for heifers to go through the signs of estrum without ovulating. Such cases make sudden recoveries. All sorts of conditions have been given credit for bringing about the cure. Change of pasture, another bull, vitamin-rich feed, such as alfalfa and green grass, mineral mixtures, bone meal, a change of climate, seasons of the year, nervous excitement and endocrine balance all have been given their turn for investigation. The fact remains that after an annoying experience and having made several diagnoses of doubtful substantiation one finds that for some unknown reason the animals conceive. For lack of a better place to discuss the problem and in the absence of a better diagnosis I am describing the condition under the heading of non-functioning ovaries.

The uterus is normal in size, tone and position. There are no body or skeletal changes as in the case of cystic ovaries. The etiology is not known. One can only look toward a lack of endocrine secretion for the answer. Cuillé and Chelle state that without ovarian atrophy and infantile uterus the diagnosis of ovarian insufficiency must be made through elimination. The repeated examination shows the absence of both Graafian follicles and corpora lutea. One may suspect a vitamin or mineral deficiency —but definite proof is not at hand.

The absence of estrum during the early periods of lactation, especially in young cows nursing their calves, is normal and the ovary contains the old corpus luteum of pregnancy. It is a wise provision of nature and not an endocrine anomaly. While the ovaries are static they are still functioning since they are holding in abeyance the return of estrum, giving the body time to recuperate from the ordeal of gestation and also to keep up its supply of nourishment for mother and calf. Therefore such an instance is not classed as a dysfunction.

AT PRESENT there is no treatment known for non-functioning ovaries. One may correct inadequate diet by providing green grass, or alfalfa, bone meal or protein in an effort to hit upon something that may be missing. I have tried several endocrine products, as well as pilocarpine and adrenalin and some cases have immediately conceived while others have remained sterile. Therefore the agent, to which is due the actual credit for the relief of the condition, remains a mystery.

Repeated vaginal examinations and an effort to bring about erection of the uterus through palpation and stimulation of the sympathetic nervous system have not made any change in the ovaries of the cases I have treated. In one case small cysts formed upon both ovaries although signs of estrum were wanting and repeated examinations revealed no change in the ovarian situation. Manual rupture of cysts was not followed by corpora lutea. Neither ovary had any lutein tissue. Still there had been no heat for a period of five months. There was a record of several services prior to conception at last breeding period. Repeated injections of 1,000 rat units of anterior lobe hormone had no effect upon the ovaries. Also a combination of estrin, and anterior lobe hormone, and adrenalin (orthosympathetic stimulant) were used without results.

However, Rulot obtained complete and immediate results from the daily trans-

plantation of certain amounts of hypophyseal tissue into the muscles of the thigh. His work was with both male and female immature and adult subjects from which the hypophysis had been removed. He found that the genital activities were awakened after two or three days of treatment and further came to the conclusion that these experiments proved that the influence exerted by the anterior lobe upon the genital tract is transmitted through the blood stream.

Working with normal animals no results were obtained from the ingestion of hypophyseal tissue, transplants produced an augmentation in the size of the ovaries, and of the uterus up to three times the weight of the same organs in untreated animals. Folliculization took place in the ovaries and functional secretions appeared throughout the genital tract.

In gravid females the effect of the transplant varied with the period of gestation and the dose employed. It interfered with nidation, follicles formed and were filled with false corpora lutea. In another instance follicles matured and burst normally followed by true corpora lutea without interruption of the gravid state. Abortion was produced where sufficient doses were given and gestation was relatively recent.

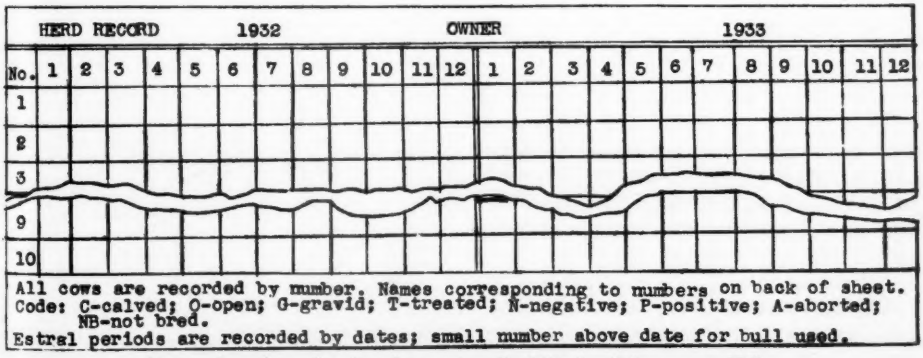
These experiments open an interesting field but have not been confirmed by clinical experience with large animals.

IN YOUNG healthy cows one should not become discouraged by early failure to relieve sterility. Unless demonstrable lesions are present most cases will eventually get with calf. Whether or not the veterinarian should receive credit for bringing about a favorable termination may be debatable. However, the very fact that he has eliminated infectious diseases and gross pathological changes is of value. On the other hand if he finds a condition that is incurable he has also rendered a valuable service, since otherwise the animal would have remained in the herd at a financial loss, as well as lowering the herd record.

There are other conditions resulting in sterility that may be due to non-functioning ovaries.

Walter Frei describes several types of ovaries that do not function because of the effect of more or less pathological changes. Whether or not endocrine dysfunction enters the picture in all those cases is doubtful. In sclerotic ovaries the connective tissue has crowded out all functioning parts of the gland. The animal evidences no heat periods and becomes sterile. The diagnosis is made upon the finding of comparatively large ovaries that reveal no evidence of Graafian follicles or corpora lutea. This, confirmed by the absence of estral periods, leads to the conclusion that the ovaries are not functioning.

Sclerotic ovaries is not a disease of young animals. Treatment is not warranted and the prognosis is unfavorable.

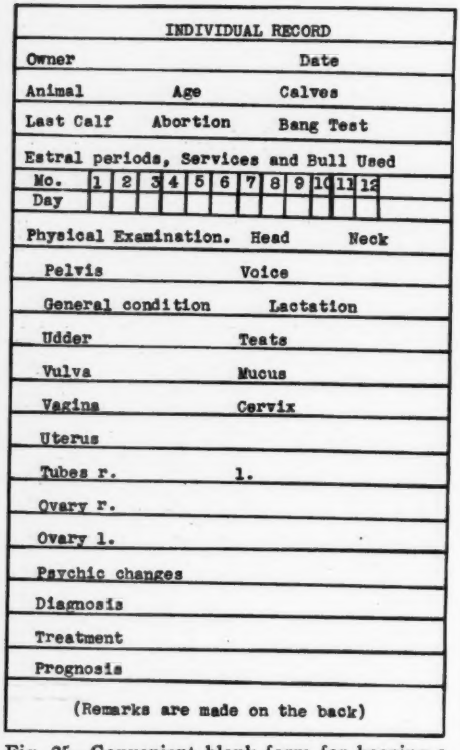

HERD RECORD
1932
OWNER
1933
No.
1 2 3 4 5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12
1
2
3
9
10
All cows are recorded by number. Names corresponding to numbers on back of sheet.
Code: C-calved; O-open; G-gravid; T-treated; N-negative; P-positive; A-aborted; NB-not bred.
Estral periods are recorded by dates; small number above date for bull used.

Convenient form for keeping a record of the herd (see page 384).

C.—Routine Examination of the Patient

A VERY important part in the training of a professional man is in the keeping of records.

History is especially necessary in the handling of sterility. The more complete the record the greater the possibility for an accurate diagnosis and treatment. It is therefore decidedly to the interest of everyone concerned that an account of everything relating to reproduction in an individual or a herd of cows be made a matter of record. Too often the veterinarian is forced to depend upon the memory of someone and incorrect data are obtained.



INDIVIDUAL RECORD

Owner Date

Animal Age Calves

Last Calf Abortion Bang Test

Estral periods, Services and Bull Used

No.	1	2	3	4	5	6	7	8	9	10	11	12
Day												

Physical Examination. Head Neck

Pelvis Voice

General condition Lactation

Udder Teats

Vulva Mucus

Vagina Cervix

Uterus

Tubes r. l.

Ovary r.

Ovary l.

Psychic changes

Diagnosis

Treatment

Prognosis

(Remarks are made on the back)

Fig. 25—Convenient blank form for keeping a record of the individual cow.

One has no right to accept a fee for work inefficiently performed and not to keep records is a mark of incompetency. Further, one owes it to the profession to perform the best possible service so that the reputation of veterinarians as a whole may not suffer at the hands of any individual. We are judged by the results we obtain, and success can come only through attention to the minutest details.

The keeping of records is not difficult. Neither does it require unlimited time. It is a matter of habit—training.

In order to make the keeping of records practical, two factors are necessary. First, a sheet carrying a routine outline must be at hand and secondly a place must be provided for keeping or filing the record in such a way that it can be located easily when needed. The form is not highly important. Once made it is filed under the owner's name and given a herd number for convenience. All individual records are placed in folders along with the herd records. The latter contains all heat periods, calving dates, services, name of bull, abortions and other relative information. A two or three-year herd-record can be kept on one sheet.

By following a definite routine one approaches the problem of sterility in an orderly and professional manner. Often an immediate diagnosis may be made from obtaining the history of the case.

The age of a cow is not an important factor in the matter of her reproductive career, except when very young or when she has reached advanced years. The reproductive period of a cow is from two to thirteen years of age although Jerseys calve at sixteen to eighteen months while cows passed sixteen years seldom conceive.

If a cow has calved once she has proved herself sound and capable of reproduction. Congenital defects and aberrations are thereby eliminated definitely. Conversely if she has reached maturity without calving, one's first thought is of some structural derangement.

A normal number of calves indicates a healthy condition and leads one to believe that she can continue to reproduce.

The regularity of estral periods serves to

eliminate all functional disturbances. Not that all functional diseases originate in the ovaries but that estrum must occur in all healthy females unless interrupted by pregnancy, dysfunction or disease. Therefore one consults that part of the record carefully that deals with dates indicating estral periods.

In the beginning single facts are grasped but as one gains in experience and training many signs are observed at one time and quickly evaluated and correlated. Among the separate factors are breed, flesh, size, conformation and deformities of the individual. Particular attention is given to the facial expression, head, neck and pelvis.

The examination of the genital tract begins with the udder, since it is a reliable indicator of events that are taking place in the remainder of the genital system. It is influenced by the endocrines of the hypophysis, the ovaries, and the placenta, and reflects with startling precision the changes that are occurring in the uterus.

The udder shows early evidence of pregnancy, and accurately foretells the approach of parturition. It also gives the alarm prior to abortion. Pyometra of long standing presents a clinical picture that in many ways resembles pregnancy. The udder remains anemic and wrinkled in such cases attracting the attention of the owner and veterinarian to the fact that pregnancy does not exist although the uterus is distended and hangs well over the pelvic brim. In many other ways the udder tells a story relative to the condition of the rest of the genital tract if the signs are interpreted.

The vulva changes in size, shape, color, and firmness, according to the age, breed, period of gestation, and health of the individual. In absence of ovarian influence it atrophies to a very small organ while the other extreme, that of maximum development occurs prior to parturition. Under estrin stimulation it becomes hard and large and during the early stages of pregnancy it is wrinkled and tucked. It relaxes as gestation progresses. In fact it keeps in tune with the rest of the genital system and responds to endocrine influences that must be considered carefully by the clinician.

Fig. 26.—A Practical Set Up for the Examination of a Patent for Pregnancy and Sterility. Every possible effort is made to maintain cleanliness.

The cervix shows marked changes during growth, estrum, and pregnancy. Each of these changes is governed by an endocrine, even to the character of the mucus that fills its lumen.

The uterus undergoes marked variation in size, texture, and position depending upon

the age and breed of the animal, the period of gestation or the disease from which the patient is suffering.

The ovaries and tubes require a most painstaking examination in order to correlate facts and signs.

Preparation of Operator

Rubber is the keynote for protection of the operator. First one dresses to meet the weather conditions. Of course all street clothes are removed and replaced by warm comfortable garments. In winter a fleece lined garment or a suit of gymnasium "sweat shirt and pants" with a pair of woolen socks provide comfort. Then one puts on rubber boots, rubber apron, rubber gloves, rubber sleeves and a rubber cap. Then when one changes from work clothes to his business suit one discards all odors and uncleanliness along with his rubber articles. A long sleeved rubber glove given a thorough washing every time it is used will last for several months and affords an invaluable protection to operator and patient alike.

The change of clothes may be made in a bathroom or dairy room where warm water and soap are available. It is our duty to leave the impression that we are professional men, cleanly in our habits and dress.

Preparation of Patient

To go about the task of diagnosing pregnancy or examining a cow for sterility requires a considerable amount of routine preparation. Usually the cow is restrained only by a stanchion. However stocks are much better and allow the operator to conduct the examination more satisfactorily. The tail must be tied around to one side. The entire field is scrubbed with soap and an aseptic solution. Biniodide (in soluble form) 1-10,000 solution protects both patient and operator. Alcohol should be used on the hands and arms when passing from one cow to another.

The most practical apparatus for carrying clean water from a bucket to the cow is a siphon made from a bent piece of copper tubing to which is attached four to six feet of rubber hose. The bent tube is hung over the side of the bucket which is hung from the ceiling or elevated in some manner. To wash one's hands in a bucket of water contaminates the entire amount and is condemned as a filthy practice.

All possible precaution must be observed against the introduction of infection into the genital tract.

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